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## ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings* series, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the eighty-third of this series.

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ALEXANDER WETMORE,

*Assistant Secretary, Smithsonian Institution.*

WASHINGTON, D. C., February 1, 1937.

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# CORYNECRINUS, A NEW DEVONIAN CRINOID GENUS <sup>1</sup>

By EDWIN KIRK

*United States Geological Survey*

IN THE collections of the United States National Museum was found an inadunate crinoid labeled, in Carl Rominger's handwriting, "*Poteriocrinus?*, Helderberg group, Clark Co., Indiana." It was almost completely embedded in hard crystalline limestone. The structures exposed, however, indicated a crinoid of unusual type, and preparation of the specimen proved it to be referable to a new genus, which is here described as *Corynecrinus*. The crinoid proves to have structural features of considerable interest, and in its relationship seems to be nearer certain European Devonian forms than any otherwise known in America.

The specimen shows the greater part of the dorsal cup, about 5 mm of the proximal portion of the column, the anal tube to a length of some 15 mm, and three of the arms to the first bifurcation, having a length about equal to that of the anal tube as preserved. The exposed surface of the specimen was somewhat weathered, intensifying fractures in the plates and in some instances making it difficult to distinguish the fractures from sutures. On the whole, however, the crinoid is in an excellent state of preservation.

## CORYNECRINUS, new genus

*Corynecrinus* is a dicyclic inadunate crinoid here referred to the new family Lecythocrinidae, of the suborder Cyathocrinoidea. The genotype is *Corynecrinus romingeri*, new species.

<sup>1</sup> Published by permission of the Director, U.S. Geological Survey.

The dorsal cup is obconical and made up of thin plates. The infrabasals form a low ring that is practically concealed by the column. The basals are large, particularly the posterior, which is considerably higher and broader than the others. The radials have a horseshoe-shaped arm-facet with a width about three-fifths that of the upper face of the radial. The outstanding characteristic of the arms is the large number of primibrachs. The brachials are perforated by an axial canal, and the food-groove is closed by a double series of covering plates. There is no special anal plate, two of the tube plates resting directly on the upper sloping shoulders of the posterior basal. The anal tube is long, slender, and composed of a few vertical series of plates. The column is large, thin walled, and quadripartite and may have had a multilocular structure.

*Corynecrinus* is most nearly comparable to *Lecythocrinus* J. Müller, to which it doubtless is closely related. The dorsal cup of *Corynecrinus*, obconical to subcylindrical in shape, is in marked contrast to the low bowl-shaped cup of *Lecythocrinus*. The most obvious difference is in arm structure, the numerous primibrachs of *Corynecrinus* being a striking and unusual feature. The anal tube of *Corynecrinus* is composed of relatively few ranges of comparatively large plates as compared with *Lecythocrinus*. The column is relatively larger in *Corynecrinus* and with a thinner wall. If a multilocular structure was present the dividing partitions were much thinner. The cross section of the column in *Corynecrinus* is subcircular rather than quadrangular.

The genotype comes from the Jeffersonville limestone (Onondaga, Middle Devonian) of Clark County, Ind., and adds another form from the Onondaga of North America that shows close relationships with the Middle Devonian crinoid fauna of Germany.

**CORYNECRINUS ROMINGERI, new species**

The dorsal cup is obconical and as preserved is slightly compressed, giving a somewhat greater breadth at the arm-bases than would be normal. This is in part compensated for by a slipping and partial overlap of the left anterior radial on the left posterior radial. As preserved the dorsal cup has a diameter of 6 mm at the base, 9 mm at the level of the arm-bases, and a height of 7.6 mm.

The infrabasals are small and almost completely concealed by the column. It is probable that the infrabasals show on the exterior as small triangular points at the lower interbasal angles and a narrow band for the rest of the circuit. The sutures do not show clearly, and it is difficult to differentiate between what might be an infrabasal ring or the proximal columnal. The posterior basal is large relative to the others, having a height of 4.8 mm as against a height of 4 mm for the adjacent basal to the left. The posterior basal is heptagonal

in outline, supporting two tube plates on its upper sloping shoulders. The other basals are pentagonal in outline with a maximum width slightly in excess of the height. The radials have a width approximately equal to the height. The horseshoe-shaped arm-facet has a width about three-fifths that of the upper surface of the radial. The right and left posterior radials abut laterally against the first pair of tube plates, and each supports a tube plate of the second range on its inner upper shoulder. The plates of the dorsal cup appear to have been devoid of ornamentation.

Nothing is known of the arms beyond the first bifurcation. In the left posterior ray the primaxil is the tenth brachial, in the left anterior ray the ninth, and in the right posterior ray probably the tenth. The arms were apparently isotomous in their division. In the left posterior ray the primibrachs range in length from 1.3 mm to nearly 2.2 mm and have an average width of about 1.7 mm. The arms are nonpinulate, and the food-groove is covered by a double row of covering plates. The brachials are perforated by an axial canal.

The anal tube is subcylindrical in section with a diameter of about 3 mm a few millimeters above the top of the dorsal cup. In its upper portion as preserved it is apparently composed of five vertical series of tube plates which in part are laterally apposed and in part imbricate. At the base of the anal tube two of the tube plates rest on the upper, sloping, subequal shoulders of the posterior basal without the interposition of a special anal plate. In the second range there are three tube plates. Of these the outer pair rest in part on the upper inner sloping shoulders of the right and left posterior radials.

The column is subcircular in section, with a very wide lumen. At a distance of 5 mm from the cup the column has a diameter of approximately 5 mm. At this point the columnar wall has an average thickness of but 0.5 mm in its thinner portions. A camera lucida outline drawing of the column in cross section is given on the plate. From this it can be seen that the lumen has a tetramerous structure. The exact outline of the inner wall is obscure, owing in part to crushing and perhaps in part to solution. There are four approximately equidistant ridges projecting from the wall into the lumen. These were grooved medially. To either side of the groove appear to have been lateral extensions, giving the ridge the appearance of a bifid column in section. It is possible that these flanges connected laterally, forming discrete camerae. If so, the encircling walls were probably very thin. The columnals are low, one of the thickest seen measuring but 0.7 mm in height.

The specific name is given in honor of Dr. Carl Rominger, one of the pioneers in mid-western American Devonian paleontology, to whose collecting ability we owe the present specimen.

*Horizon and locality.*—As noted above, Rominger's original label reads "Helderberg group, Clark County, Indiana." From the lithology of the matrix and the associated corals it is evident that the specimen was collected in the Jeffersonville limestone (Onondaga, Middle Devonian), probably from the lower coral zone.

*Type.*—U.S.N.M. no. 90094.

### LECYTHOCRINIDAE, new family

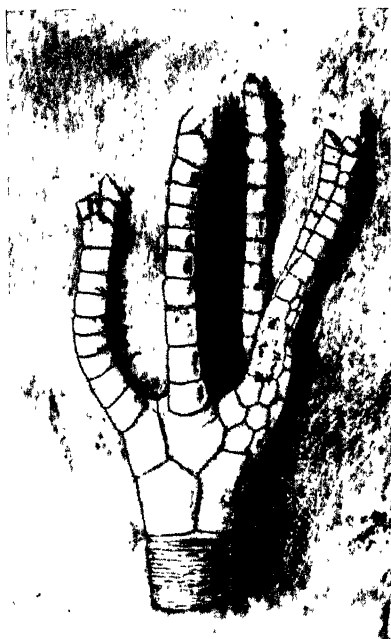
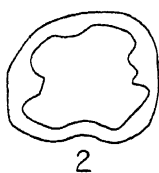
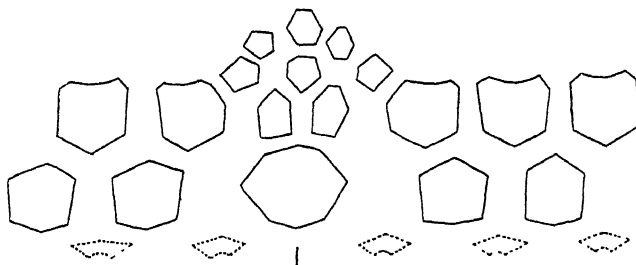
The family *Lecythocrinidae* is referable to the *Cyathocrinoidea* and is nearly related to the *Gasterocomidae*. *Lecythocrinus* has previously been placed in the *Cyathocrinidae* by Bather (1900) and following him in the equivalent subfamily *Cyathocrininae* by Springer (1913). Jaekel (1918) placed *Lecythocrinus* in the *Gasterocomidae*. Two genera are here referred to the family *Lecythocrinidae*, *Lecythocrinus* J. Müller and *Corynecrinus*, new genus. Both are from approximately equivalent horizons in the Middle Devonian.

The column has a large lumen that may be divided by partitions into a central canal and four peripheral canals. There is no differentiation of a special anal plate, two of the proximal tube plates normally resting directly on the posterior basal. The anal tube is long and relatively slender.

The family differs from the *Cyathocrinidae* in the character of the column and the lack of a special anal plate. From the *Gasterocomidae* the *Lecythocrinidae* differ mainly in the possession of an anal tube, although it is probable that the brachial structures also differed widely.

Inasmuch as there is considerable bibliographic confusion in regard to the status of *Lecythocrinus*, which I have chosen as the type of the new family, it seems desirable briefly to give the history of the genus.

J. Müller (1858, p. 196) proposed the new genus *Lecythocrinus* with *L. eifelianus*, new species, as the only species referred to it. This must of necessity be the genotype. Schultze (1867) figured the original specimen of Müller and gave additional figures of other specimens. He did not recognize either the genus *Lecythocrinus* or the species *eifelianus* of Müller, placing the genus in synonymy with *Taxocrinus* and the species in synonymy with his "new species" *T. briareus*. The excuse for the latter high-handed measure was that Müller's species was based on an abnormal specimen. Wachsmuth and Springer (1880, p. 313; sep., p. 88) cite *Lecythocrinus* as "Zittel (not Joh. Müller)" and follow Schultze in throwing *L. eifelianus* in synonymy with Schultze's *T. briareus*. Wachsmuth (1896, p. 156) cites *Lecythocrinus* as "Müller, emend. Zittel" and in a footnote says in part: "The type-specimen upon which this genus was founded (*L. eifelianus* Müll.)" etc. He also labels figure 261, page 157, which is a copy of Schultze's restoration of the species, "*Lecythocrinus eifelianus* Müll." Bather (1900, p. 175) quotes *Lecythocrinus* as



**CORYNECRINUS ROMINGERI, NEW GENUS AND NEW SPECIES**

1, Analysis of plates, X2. 2, Camera lucida drawing of section of column, X4. 3, Left posterior radius, X2. 4, Posterior interradius, X2. (Magnifications approximate.)



"Müller (1858, em. Zittel, 1879 = *Taxocrinus briareus*, Schultze, 1866)." Springer (1913, p. 221) quotes the genus as "Joh. Müller (*Taxocrinus briareus* Schultze)." It seems imperative to restore Müller's *Lecythocrinus eifelianus* to good standing, with *Taxocrinus briareus* Schultze as a synonym. As to the authority for the genus, this must rest with J. Müller.

The restoration of *Lecythocrinus eifelianus* Müller given by Schultze (1867) as figure 1b on plate 4 is probably a composite of two different genera. The shape of the arm ossicles and apparently the size and proportions of the anal tube seem to have been taken from the specimen illustrated as figure 1f on the same plate, which is probably not referable to *Lecythocrinus*. Careful preparation of a specimen of *Lecythocrinus eifelianus* from Gerolstein in the Springer collection shows the anal tube to be relatively slender and probably shorter than as restored by Schultze.

The presence of an anal tube in the *Lecythocrinidae* with apparently no special anal plate in the dorsal cup is of very great interest. Such structures possibly indicate the origin of a ventral tube by a process at variance with that commonly postulated for most of the *Inadunata*. Without going into the highly controversial subject of the origin of crinoid anal structures it nevertheless seems worth while to point out certain possible trends in the evolution of the ventral tube as shown by the group under consideration.

To begin with it is naturally open to question whether anal  $\alpha$  is not present as one of the plates which I call tube plates. Müller's original type of *Lecythocrinus eifelianus* as figured by Schultze (1867, pl. 4, fig. 1a) shows a posterior interradius that is essentially cyathocrinoid. Figure 1i on the same plate, with which the specimen in the Springer collection agrees, and the type of *Corynecrinus romingeri* all have two subequal plates resting on the upper sloping shoulders of the posterior basal. With the exception of the *Gasterocomidae*, I have met with but two instances among the *Cyathocrinoidea* where the posterior basal supports two subequal plates. These are evidently abnormal, but, as is often the case, variations from the normal may indicate possible normal evolutionary trends. Angelin (1878, pl. 23, fig. 13) figured a specimen of "*Cyathocrinus glaber* Ang." in which the posterior interradius is much like that of *Corynecrinus* in that the large posterior basal supports tube plates instead of the single large anal characteristic of *Cyathocrinus*. Bather (1893, p. 139) states that the original of this figure could not be found. In regard to the structure of the posterior interradius he says: "The peculiarity in its structure, if we assume some degree of correctness in the figure, appears to have been the absence of anal  $\alpha$ , or what is more probable, its fusion with the posterior basal." With the accuracy of the drawing questioned and the original specimen misplaced, there is little use in doing other



than calling attention to the figure. I have seen a similar structure in *Crotalocrinus cora* Hall in the collections of the United States National Museum. Here instead of the normal anal plate two subequal plates rest on the posterior basal.

Were the structures figured by Angelin correct, I still would not subscribe to Bather's explanation that anal  $x$  had fused with the posterior basal. Absent it might be, but as in the case of the specimen of *Crotalocrinus cora* I would rather assume that a tube plate had migrated downward to a level with anal  $x$ . I agree that so far the same explanation might be given for the structures found in *Lecythocrinus* and *Corynecrinus*. In this case Müller's type would be considered the norm and the two plate condition variants from the normal structure.

I suggest, however, that the anal structures of the Lecythocrinidae may have evolved from a type essentially like those found in the Gasterocomidae, crinoids to which I believe the Lecythocrinidae are closely related. The lateral anal opening of such a form as *Gasterocomoma* may notch the distal face of the posterior basal or be separated from it by small plates. In one specimen of *Gasterocomoma antiqua* Goldfuss in the Springer collection two plates rest on the upper sloping shoulders of the posterior basal. A posterior view of the specimen could easily pass as a view of *Lecythocrinus* in which the ventral tube had been broken away. In some specimens of *Gasterocomoma* there is a well-defined anal pyramid of small plates much like the structures to be found in certain of the early Cyathocrinoidea such as *Carabocrinus*. It seems to me quite reasonable that the ventral tube of the Lecythocrinidae might have arisen as a simple prolongation of such an anal protuberance. Subsequently a single tube plate may have become centered on the posterior basal, as I conceive to be the case in Müller's type of *Lecythocrinus eifelianus*, and give a remarkable simulacrum to a true anal  $x$ .

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# AMERICAN MUSCOID FLIES OF THE GENERA CERATOMYIELLA AND PARADIDYMA

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THIS paper contains a discussion of the generic characters of the tachinid genera *Ceratomyiella* and *Paradidyma*, keys for separating the species in both sexes, and descriptions of 24 species, of which 15 are new to science. The material used is preserved in the United States National Museum, the Kansas University Museum, and my own collection.

I am under great obligations to the late Dr. J. M. Aldrich for the privilege of studying the material in the National Museum collection, which he kindly assembled and forwarded to me, and for carrying on considerable correspondence, in which very helpful notes on the genotype of *Paradidyma* were supplied through the generous cooperation of Miss Daphne Aubertin, of the British Museum. To Dr. R. H. Beamer I am indebted for permission to examine the type specimens of *Lachnomma magnicornis* Townsend and *Atrophopoda braueri* Williston, in addition to other material, in the Kansas University Museum.

The genera here under consideration may be readily recognized by the row of bristles extending down the inner margin of the parafacial and the bare first vein of the wing. In the female the fore claws and pulvilli are small or atrophied. There are a number of genera sharing this combination of characters except that the first vein of the wing is beset with hairs. Among approximately 200 specimens of *Ceratomyiella* and *Paradidyma* examined in the pres-

ent study, I have seen but one specimen (*P. singularis*) in which the first vein is not entirely bare; this specimen has only one or two hairs present on the vein. When the persistently bare first vein is considered throughout the group, the character seems to be of generic importance, and I have included in the present genera only those forms that agree in this respect.

### Genus CERATOMYIELLA Townsend

*Ceratomyiella* TOWNSEND, Trans. Amer. Ent. Soc., vol. 18, p. 379, 1891. (Genotype, *C. conica*, new species.)—BRAUER and BERGENSTAMM, Die Zweifeltigler des kaiserlichen Museums zu Wien, no. 6, p. 189, 1893.—ALDRICH, Catalogue of North American Diptera, p. 427, 1905.

*Atrophopalpus* TOWNSEND, Ent. News, vol. 3, p. 130, 1892. (Genotype, *A. angusticornis*, new species.)—COQUILLET, Revision of the Tachinidae of America, p. 126, 1897.—ALDRICH, Catalogue of North American Diptera, p. 475, 1905.

*Oedemapeza* TOWNSEND, Smithsonian Misc. Coll., vol. 51, p. 65, 1908. (Genotype, *Atrophopoda townsendi* Williston.)

All of the type species concerned have been examined in arranging the above synonymy. The principal character, listed among others in the description of *Atrophopalpus*, is the reduced size of the palpi; although somewhat smaller than in the genotype of *Ceratomyiella*, they are nevertheless distinctly developed, and the relative difference in size can hardly be considered of more than specific importance. *Oedemapeza* was established by the mere citation of a species as the type. The genus *Ceratomyiella* is closely related to *Paradidyma*, from which it differs most obviously in having the eyes bare.

*Generic characters* (from the type species).—Eyes bare. Front not prominent at antennae, where the length of head distinctly exceeds the vibrissal axis. Antennae nearly as long as face, inserted above middle of eyes, basal segments short. Arista with short basal segments. Face receding, the depression broad and deep. Facial ridges practically bare, weakly divergent below. Parafacial with a row of bristles on the inner margin extending from the lowermost frontals to level with lower edge of eye. Vibrissae situated on the front edge of mouth. Proboscis short, labella fleshy. Palpi rather short and slender. Cheek one-third to two-fifths the eye height. Male with one pair, female with two pairs, of proclinate orbital bristles. Frontals extending below middle of second antennal segment, uppermost larger, reclinate. Ocellars present, proclinate. Inner verticals developed, outer pair moderately developed in female, vestigial in male.

Thoracic chaetotaxy: Acrostichal, 2, 1 (postsutural pair hairlike, situated in transverse line with hindmost dorsocentrals); humeral, 2;

posthumeral, 1; presutural, 1; dorsocentral, 2, 3; notopleural, 2; intraalar, 2; supraalar, 3; postalar, 2; hypopleural, 3 or 4; pteropleural, 1 (small); sternopleural, 1, 1; scutellum with two laterals besides one smaller decussate apical pair. Postscutellum normally developed. Infrascapular hairs absent.

Abdomen rather narrow and slightly elongate, without discal bristles.

Legs long and slender; fore tarsi in female compressed and swollen, the basal segment nearly as long as tibia, claws and pulvilli minute; in male the fore tarsi normal with short but distinct claws and pulvilli.

Wings normal in shape; veins bare except the third, which is setulose almost to small cross vein; last section of fifth vein short; apical cell closed with a short petiole reaching costa shortly before wing tip; costal spine developed.

#### KEY TO SPECIES OF CERATOMYIELLA

1. Apical cell closed and usually petiolate..... 3.  
Apical cell open..... 2.
2. Male with orbitals; epaulets black; last three abdominal segments largely gray pollinose, the narrow hind margins subshining, male only (New Jersey)..... (5) *orbitalis*, new species.  
Male without orbitals; epaulets red; last three abdominal segments shining black on apical half; third antennal segment in female very slender (Florida)..... (4) *angusticornis* (Townsend).
3. Legs black..... 4.  
Femora reddish yellow (United States, widespread)..... (1) *conica* Townsend.
4. Parafacial bristles reduced to small hairs in upper half of row; fourth abdominal segment polished black, usually without pollen; petiole of apical cell shorter than small cross vein (Texas, New Mexico, Arizona)..... (3) *bicincta*, new species.  
Parafacial bristles not noticeably reduced in size above; fourth abdominal segment thinly pollinose on basal third; petiole of apical cell about one-third the length of apical cross vein, male only (West Indies)..... (2) *townsendi* (Williston).

#### (1) CERATOMYIELLA CONICA Townsend

*Ceratomyiella conica* TOWNSEND, Trans. Amer. Ent. Soc., vol. 18, p. 380, 1891.

*Male*.—Front at vertex 0.3 and 0.31 of the head width (two specimens), gradually widening to antennae; median stripe reddish brown, hardly more than half the parafrontal width on entire length; parafrontals black and subshining, viewed from the side thinly pollinose; face and parafrontals thinly gray pollinose; antennae reddish black, third segment broader than parafacial, six or seven times longer than second; arista brown, thickened about to middle; palpi

pale yellow, slender to tip; back of head shining black above, thinly gray pollinose and sparsely pale haired downward.

Thorax black, lightly dusted with gray pollen; dorsal black stripes poorly defined behind suture; scutellum black, indistinctly pollinose, without discals; infrascapular hairs absent; calypters transparent, front lobes colorless, hind ones tawny.

Abdomen shining black, last three segments pruinose on basal third; first and second segments bearing a pair of median marginal bristles; third and fourth each with a marginal row of six or eight; no discals.

Legs reddish yellow, tibiae more or less infuscated, tarsi black.

Wings with a tawny tinge, paler on hind margins; hind cross vein perpendicular to fourth, which it joins slightly nearer bend than small cross vein; epaulets red.

*Female*.—Front at vertex 0.27 and 0.25 of the head width in two specimens; third antennal segment slender, about five times longer than second; arista thickened near the base, clothed with short hairs; cheek about one-third the eye height; front tarsi as noted under generic description.

*Length*.—5 mm.

*Remarks*.—Redescribed from 2 males and 2 females: 1, College Station, Tex., December 4, 1932 (H. J. Reinhard); 1, A. and M. College, Miss. (F. M. Hull); 1, Opelousas, La., without collector's label; and the other, Dead Run, Fairfax County, Va. (R. C. Shannon). The type locality is Carlinville, Ill. The species is easily recognized by the red femora.

## (2) CERATOMYIELLA TOWNSENDI (Williston)

*Atrophopoda townsendi* WILLISTON, Trans. Ent. Soc. London, 1896, p. 356, pl. 11, fig. 93.

*Paradidyma townsendi* ALDRICH, Catalogue of North American Diptera, p. 474, 1905.

*Oedemapeza townsendi* TOWNSEND, Smithsonian Misc. Coll., vol. 51, p. 65, 1908.

*Male*.—Front at vertex 0.28 and 0.27 of the head width in two specimens, widening uniformly downward; parafrontals blackish, thinly dusted with white pollen; median stripe reddish brown, slightly narrower than one parafrontal on entire length; frontal bristles about five in number, extending to level with apex of second antennal segment, uppermost pair of moderate length, reclinate, others directed inward; ocellars small but distinct, proclinate; one proclinate orbital bristle situated at middle of front; verticals one pair (inner) developed; face moderately excavated, receding, gray pollinose, its ridges bare; parafacials narrow, gray pollinose, bearing a row of moderate-sized bristles on inner margin, bare outside

the main row; vibrissae situated on oral margin; antennae as long as face, basal segments yellow, third brownish, thickly covered with dense pale pubescence and about seven times longer than second segment; arista about as long as third antennal segment, thickened on proximal third, reddish, basal segments darker, short but distinct; eyes bare; cheek in profile about one-fifth the eye height; proboscis short; palpi slender, pale yellow; back of head subshining above, gray pollinose and pale haired below.

Thorax and scutellum black, dusted with gray pollen; mesonotum marked with two heavy black stripes, which extend from the anterior margin to base of scutellum without interruption at suture; chaetotaxy as in *C. conica*; postscutellum thinly gray pollinose; no infra-squamal hairs; calypters transparent, faintly tawny.

Abdomen rather slender, shining black; intermediate segments with bluish-white pollen bands on basal fourth above, becoming wider on the sides and venter; fourth segment pruinose on proximal third; two basal segments each with a pair of median marginal bristles; third and fourth with a marginal row; no discals; genital segments black, small, and retracted.

Legs rather long and slender, blackish; front claws and pulvilli short but distinct.

Wings tinged with brown on anterior margin, grayish hyaline behind; veins bare except third, which is haired to small cross vein; hind cross vein perpendicular to fourth, joining it midway between bend and small cross vein; apical cell closed, the petiole nearly one-third the length of the broadly concave apical cross vein, reaching costa shortly before tip of wing; costal spine small.

*Length*.—4 mm.

*Remarks*.—Redescribed from two males in my collection from the West Indies, donated by D. G. Hall; labeled "Mustique Island, May."

The species varies considerably in the degree of infuscation of the wings. Four specimens in the United States National Museum, according to Dr. J. M. Aldrich, all have the wings more distinctly infuscated than described above, agreeing better in this respect with Williston's description. The species is closely related to *conica*, from which it is readily distinguished by the black legs, longer petiole of apical cell, and other characters.

I have not seen any specimens of the female. The type locality is St. Vincent, British West Indies.

(3) *CERATOMYIELLA BICINCTA*, new species

*Male*.—Front at vertex 0.297 of the head width (one specimen), not prominent at antennae; parafrontals gray pollinose to vertex,



bearing a few scattered inconspicuous hairs outside of frontal rows; median stripe short, brownish black, narrower than one parafrontal on entire length; verticals two pairs, outer ones about half as long as inner, curving outward and backward; ocellars present, proclinate; frontals about five in the row, extending about to middle of second antennal segment, uppermost pair larger and reclinate, the pair next in front of these erect, decussate at tip, others directed inward; one proclinate orbital bristle situated midway between the anterior ocellus and base of antennae; face rather long and deep, gray pollinose on reddish ground color, its ridges hardly divergent downward, practically bare; vibrissae on the front edge of the mouth; parafacials narrow, gray pollinose, bearing a row of bristles which are reduced to small hairs on the upper half; antennae reddish yellow, as long as the face, third segment darker, about seven times longer than second, which bears one long and numerous shorter bristles on front side; arista about as long as third antennal segment, finely pubescent, thickened and yellow on proximal two-fifths, black beyond, penultimate segment about twice as long as broad; proboscis short, labella fleshy; palpi slender to tip, pale yellow, bearing a few short black hairs near apex; cheek bare, gray pollinose on red ground color, about one-fourth the eye height; posterior orbits broad to middle, thence narrowed upward, thickly covered with gray pollen; back of head sparsely pale haired, gray pollinose; eyes bare.

Thorax black, gray pollinose; mesonotum marked with three broad pale gray and two slightly narrower opaque black stripes, which extend from the anterior margin to base of scutellum; the latter black, dusted with changeable gray pollen, bearing two laterals (with a large supernumerary bristle on one side), apical pair strongly decussate; other details of chaetotaxy as in *conica*; calypters transparent, white; postscutellum normal; no infrascutal hairs.

Abdomen shining black; intermediate segments with silvery bands on basal fourth to third, extending on venter to median line; first and second segments each with a pair of median marginal bristles; third with four marginals, none below the lateral pair; fourth with a complete marginal row of about 12; no discals; genitalia small, retracted; inner forceps blackish, short and united, moderately wide at base, which is haired behind, tapering sharply to middle, slender and shining beyond, tip acute; outer forceps largely yellow, convex on outer side, tips acute and blackish, slightly longer than inner ones; penis short, black, apex bordered with a narrow white membrane; fifth sternite narrowly and deeply incised, the lobes shining black, sparsely clothed behind with short, black hairs.

Legs largely black, trochanters yellow, coxae less distinctly so; fore tarsal segments normal, the claws and pulvilli short but distinct; mid tibia with a whorl of three bristles near middle, the one on outer front side stout; hind tibia with only three strong bristles on outer posterior edge.

Wings with a brownish tinge on broad anterior margin, somewhat paler behind; venation bare except third vein, which is setulose almost to small cross vein; fourth vein with a broadly rounded stumpless bend, concave beyond; hind cross vein perpendicular to fourth, joining it midway between small cross vein and bend; apical cell closed, petiole short, reaching costa shortly before the wing tip; epaulets blackish; costal spine developed but not very strong.

*Female*.—Front at vertex 0.296 of the head width (average of five: 0.3; 0.29; 0.29; 0.29; 0.29), widening uniformly to antennae; the usual two proclinate orbitals present; verticals two pairs; antennae a little shorter than face, third segment narrow but wider than parafacial below, about five times longer than the second; arista thickened on proximal fourth, pubescent to tip; cheek about one-fourth the eye height; fore tarsi compressed, the segments slightly swollen, claws and pulvilli minute.

*Length*.—Male, 6 mm; female, 5.5 to 7 mm.

*Type*.—Male, U.S.N.M. no. 44758, from College Station, Tex.

*Remarks*.—Described from eight specimens. In my collection, 1 male and 3 females, College Station, Tex., September 25 and October 11, 1930, August 24, 1931, and October 19, 1933 (H. J. Reinhard). In the United States National Museum, 4 females as follows: 1, Brownsville, Tex., June (C. H. T. Townsend); 1, Yuma, Ariz., June 26, 1917 (J. M. Aldrich); 2, Las Cruces, N.Mex., one labeled "Ckll. 2293, Aug. 1894", the other without collector's label. The specimen collected by Cockerell also bears Coquillett's determination label, *Paradidyman singularis* Townsend.

The species is strictly congeneric with the type species, *conica*, from which it differs in having black legs and broad, well-defined thoracic stripes; in being more robust in build; and in other characters.

(4) *CERATOMYIELLA ANGUSTICORNIS* (Townsend)

*Atrophopalpus angusticornis* TOWNSEND, Ent. News, vol. 3, p. 130, 1892.

*Male*.—Front at extreme vertex 0.271 of the head width (one specimen), widening gradually downward to antennae; sides of front, face, and cheeks gray pollinose; median stripe red, narrower than one parafrontal; outer verticals and orbitals absent; ocellars proclinate; uppermost frontal reclinate, others directed inward, extending below middle of second antennal segment; face rather deeply excavated, receding and concave above mouth in profile; facial ridges

moderately divergent downward, practically bare; vibrissae on level with front edge of mouth; antennae as long as the face, basal segments yellow, second distinctly longer than the first and about one-sixth the length of third, which is black except at extreme base; arista brown, thickened on basal fourth, slender beyond middle, second segment short; parafacial bearing a row of bristles, which become longer and stronger downward, a few hairs outside the large bristles on lower extremity; cheek nearly two-fifths the eye height; palpi but little longer than thickness of proboscis at point of attachment, pale yellow, bearing two black hairs near apex; eyes practically bare.

Thorax and scutellum black, gray pollinose; four black stripes on mesonotum, outer ones broader, stopping shortly before base of scutellum. Chaetotaxy as in *conica*; scutellum with two laterals (posterior pair large and divergent), one decussate apical and a weak discal pair; postscutellum thinly pollinose; infrascapular hairs absent; calypters tawny.

Abdomen shining black on broad hind margins of last three segments, basal segment without, second with one pair of large median marginal bristles; third and fourth each with a complete row of about 12; no discals; inner forceps united, slender on apical half, in profile slightly bowed forward at tip; penis simple, terminating in a short pale membrane; fifth sternite with a narrow deep incision, the lobes blackish.

Legs reddish black; claws and pulvilli moderately elongated.

Wings subhyaline; venation normal; third vein with hairs extending almost to small cross vein; apical cell open shortly before the wing tip; costal spine strong; epaulets red.

*Female*.—Front at vertex 0.292 of the head width (one specimen); third antennal segment very slender, four to five times longer than second; outer verticals not developed; two pairs of proclinate orbitals; fore tarsi rather slender, compressed and tapering outward, claws and pulvilli minute.

*Length*.—6.5 to 7.5 mm.

*Remarks*.—Redescribed from one male and one female in the United States National Museum from Miami, Fla., October 8 and 15 (C. H. T. Townsend).

(5) *CERATOMYIELLA ORBITALIS*, new species

*Male*.—Front at vertex 0.25 of the head width (one specimen), widening gradually downward to antennae; parafrontals gray pollinose to vertex, sparsely haired; median stripe reddish brown, as wide as one parafrontal except at antennae; one pair of weak orbitals present; outer verticals not developed; ocellars proclinate; frontal

bristles about seven in number, descending below middle of second antennal segment, uppermost pair reclinate, hardly larger than the next preceding ones in the row; face moderately receding, rather long and deeply excavated, its ridges not strongly divergent below, bare except one or two bristles above vibrissae, which are situated on the front edge of mouth; antennae as long as face, basal segment short, second wholly yellow, about one-fifth the length of third, which is blackish beyond the narrow base; arista brown, thickened on basal fourth, second segment short; parafacials gray pollinose, bearing a row of strong bristles along the inner margin, those in lower part of row larger than any of the frontals, a few hairs extending outside the large bristles on the lower extremity; cheek about two-fifths the eye height; palpi small, yellow, bearing two slender black hairs near tip; labella pale yellow, fleshy; eyes bare; back of head gray pollinose; thinly clothed with pale hairs.

Thorax and scutellum black, gray pollinose; mesonotum marked with four narrow black stripes; chaetotaxy as in *conica*; postscutellum normally developed; infrascapular hairs absent; calypters white.

Abdomen black, subshining; the pollen gray, apparent on sides of first segment, thicker on the basal margins of last three and extending rather thinly past the middle on each; first segment with a weak pair of median marginals; second with one pair (broken off, scars indicating strong bristles); third and fourth each with a complete marginal row; no discs on anal segment.

Legs black, basal segments reddish; claws and pulvilli elongate.

Wings subhyaline; veins bare except third, which is setulose two-thirds of the distance to small cross vein; last section of fifth vein short; fourth vein with a broadly rounded bend, beyond slightly concave to costa; apical cell open just before the extreme wing tip; epaulets black; costal spine developed.

*Length*.—8 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44759.

*Remarks*.—Described from one male in the United States National Museum from Hammonton, N.J., August 23, 1903; no collector's label.

#### Genus PARADIDYMA Brauer and Bergenstamm

*Paradidyma* BRAUER and BERGENSTAMM, Die Zweiflügler des kaiserlichen Museums zu Wien, no. 5, p. 382, 1891; no. 6, p. 184, 1893. (Genotype, *Didyma validinervis* Van der Wulp.)—COQUILLETT, Revision of the Tachinidae of America, p. 126, 1897.—ALDRICH, Catalogue of North American Diptera, p. 474, 1905.

*Atrophopoda* TOWNSEND, Trans. Amer. Ent. Soc., vol. 18, p. 373, 1891 [Genotype, *A. singularis*, new species (female only)]; Smithsonian Misc. Coll., vol. 51, p. 66, 1908.

*Lachnomma* TOWNSEND, Trans. Amer. Ent. Soc., vol. 19, p. 103, 1892. [Genotype, *L. magnicornis*, new species (male only) = *Atrophopoda singularis* Townsend. I have examined the type specimen.]

*Microchira* BRAUER and BERGENSTAMM, Die Zweiflügler des kaiserlichen Museums zu Wien, no. 6, p. 188, 1893. [Genotype, *M. mexicana*, new species (male only) = *Paradidyma aperta* Brauer and Bergenstamm, loc. cit., p. 187.]

*Lachnommopsis* TOWNSEND, Proc. U.S. Nat. Mus., vol. 49, p. 421, 1915. [Genotype, *L. armata*, new species (male only).]

*Phytoadmontia* TOWNSEND, Proc. U.S. Nat. Mus., vol. 49, p. 628, 1916. (Genotype, *Admontia setigera* Coquillett.)

In arranging the foregoing synonymy, I have examined all the type species involved. *Atrophopoda braueri* Williston, listed as a synonym of *Paradidyma* by Aldrich<sup>1</sup> and Coquillett,<sup>2</sup> does not come within the limits of the genus as restricted herein. I have examined a male type specimen in the Kansas University Museum. It has the eyes practically bare, and the first vein of the wing is setulose on almost the entire length. For this species Townsend<sup>3</sup> established *Diaphoropeza*, which Coquillett<sup>2</sup> also placed in synonymy with *Paradidyma*. Under the rules of the International Code the genus is valid, although no description of the generic characters was given.

*Generic characters* (from the type species).—Eyes distinctly hairy. Front in male narrowed behind and rather prominent at base of antennae. Face receding, moderately excavated, its ridges normally divergent downward, in profile concave above mouth with the front edge of latter slightly prominent between vibrissae. Antennae inserted about on level with middle of eye, extending almost to oral margin, basal segments subequal in length in male. Second segment of arista short. Parafacial with a row of macrochaetae on the inner margin extending from lowermost frontal almost to lower edge of eye. Vibrissae situated on level with oral margin. Facial ridges bearing a few bristles and hairs above the vibrissae. Proboscis shorter than height of head, distal segment moderately slender, labella fleshy. Palpi normal in size, slender, tips hardly thickened. Frontal rows moderately divergent beneath base of antennae, extending to base of third segment. Ocellars present, proclinate. Orbitals absent in male. Cheek about one-half the eye height. Back of head densely pale haired, with a row of black hairs below the orbital fringe.

Thoracic chaetotaxy: Acrostichal, 2, 1 (postsutural pair well developed, situated in transverse line with posterior dorsocentral pair);

<sup>1</sup> A catalogue of North American Diptera. Smithsonian Misc. Coll., vol. 46, p. 474, 1905.

<sup>2</sup> The type-species of the North American genera of Diptera. Proc. U.S. Nat. Mus., vol. 37, p. 532, 1910.

<sup>3</sup> Smithsonian Misc. Coll., vol. 51, no. 2, p. 64, 1908.

dorsocentral, 3, 3; humeral, 2; posthumeral, 1; presutural, 1; notopleural, 2; intraalar, 2; supraalar, 2; postalar, 2; hypopleural, 4 or 5; pteropleural, 1 (small); sternopleural, 2, 1 (lower anterior one small). Scutellum with two lateral, one decussate apical and a small discal pair. Postscutellum normally developed; infrascapular hairs present.

Abdomen without discal bristles on intermediate segments.

Legs rather long and slender, claws and pulvilli elongate in male.

Wings with first vein bare; third bristled nearly to small cross vein. Costal spine developed. Last section of fifth vein less than half as long as the preceding one. Hind cross vein oblique to fourth, which it joins a little nearer bend than small cross vein. Apical cell narrowly open, reaching costa well before extreme tip of wing.

#### KEY TO SPECIES OF PARADIDYMA

##### MALES

1. Apical cell closed and petiolate----- 2.  
Apical cell open----- 4.
2. Mesonotum gray pollinose, the black stripes conspicuous and usually fused into a single broad pair, which extends to base of scutellum----- 3.  
Mesonotum subshining, at most lightly dusted with pollen, the black stripes poorly defined or entirely obliterated behind suture; third antennal segment ordinary; arista thickened on basal two-fifths (Indiana, Illinois, Maryland, Virginia).  
(23) *petiolata*, new species.
3. Last three abdominal segments with silvery bands on basal third, the remainder of these segments including the first shining black; third antennal segment entirely black (United States, widespread)----- (22) *singularis* (Townsend).  
Pollen on abdomen not in defined basal bands, first segment conspicuously pollinose on the sides above, the second with pollen extending to hind margin; base of third antennal segment yellow to insertion of arista (Brazil).  
(21) *brasiliانا*, new species.
4. Last section of fifth vein one-half the length of preceding section----- 5.  
Last section of fifth vein distinctly less than one-half as long as preceding section----- 8.
5. Acrostichals only two pairs well developed before suture----- 6.  
Three pairs of strong presutural acrostichal bristles; palpi brownish; abdomen almost wholly covered with gray pollen; fourth segment bearing a row of strong discal bristles (New Mexico)----- (8) *neomexicana*, new species.
6. Second antennal segment distinctly longer than first----- 7.  
Basal segments of antennae subequal in length; pollen on thorax and abdomen tinged with brown; postsutural acrostichals one pair; calypters tawny (Mexico)--- (9) *derelicta*, new species.
7. Last three abdominal segments with defined silvery bands on basal fourth, the remainder of these segments including the first shining black; mesonotum thinly pollinose, subshining; palpi pale yellow; two sternopleural bristles (Utah).  
(11) *retracta*, new species.

- Pollen on last three abdominal segments not in defined cross bands, the first pollinose on the sides; mesonotum covered with dense cinereous pollen, the black vittae very distinct behind suture; palpi brownish black; three sternopleurals (Utah)----- (10) *cinerescens*, new species.
8. Front narrowed behind the middle; orbital bristles absent----- 9.  
 Front almost uniform in width to vertex; one pair of orbitals present; arista thickened on proximal three-fourths; palpi and second antennal segment yellow; verticals two pairs developed; fourth abdominal segment without discals (Peru).  
 (24) *armata* (Townsend).
9. Sides of face bare below level of arista outside main row of bristles----- 11.  
 Sides of face with hairs extending on lower half outside of parafacial row----- 10.
10. Bristles on lower half of face distinctly longer than those above and approximating the frontals in size; arista bare, thickened on proximal two-thirds; face strongly receding; palpi dark brown; small cross vein infuscated; epaulets black (Mexico, New Mexico)----- (12) *crassiseta*, new species.  
 Parafacial bristles about equal in length throughout entire row, and less than half the size of frontals; arista pubescent, thickened hardly to middle; palpi pale yellow; abdomen wholly gray pollinose; wings hyaline; epaulets red (New Mexico)----- (13) *aristalis*, new species.
11. Fourth abdominal segment with discal bristles above----- 12.  
 Fourth abdominal segment without discals above; first segment bearing a pair of median marginals; front about one-half eye width; arista distinctly pubescent (Texas, North Carolina, Guatemala)----- (18) *apicalis*, new species.
12. First abdominal segment with a pair of median marginal bristles; arista pubescent; front narrow, 0.22 of head width; third antennal segment four times length of second (Mexico)----- (20) *validinervis* (Van der Wulp).  
 First abdominal segment without median marginals; arista bare; front rather wide, about 0.29 of head width; third antennal segment six to seven times longer than second (United States, widespread)----- (19) *affinis*, new species.
1. Fore tarsal segments compressed and swollen, claws and pulvilli minute or atrophied----- 4.  
 Fore tarsal segments ordinary, the claws and pulvilli well developed----- 2.
2. Last section of fifth vein one-half as long as preceding section----- 3.  
 Last section of fifth vein about one-third length of preceding section; third antennal segment as wide as parafacial and three times length of second; abdomen thinly gray pollinose, subshining; costal spine longer than small cross vein; wings hyaline (California, Arizona)----- (6) *setigera* (Coquillett).
3. Abdomen shining black, last three segments with pollen in defined bands on basal fifth; palpi pale yellow; sternopleurals, 2; no infrasquamal hairs; small species, length 4 mm (Idaho)----- (7) *obliqua*, new species.

- Abdomen wholly gray pollinose; palpi dark brown; sternopleurals, 3; infrascapular hairs present; larger species, length 8 mm----- (8) *neomexicana*, new species.
4. Sides of face bare below level of arista outside main row of bristles----- 5.  
Sides of face outside main row of bristles with coarse black hairs extending almost to cheeks; pollen on head golden; abdomen wholly pollinose (Mexico).  
(14) *aperta* Brauer and Bergenstamm.
5. Fourth abdominal segment with a row of discals extending across the top----- 9.  
Fourth abdominal segment without median discal bristles above----- 6.
6. Outer verticals not developed----- 7.  
Outer vertical bristles almost as large as inner ones; abdomen wholly gray pollinose; arista thickened beyond middle (Peru)----- (24) *armata* (Townsend).
7. Venter of abdomen clothed with only short black hairs----- 8.  
Venter bearing long pale or whitish hairs; palpi black; wings strongly infuscated; antennae wholly black (Peru).  
(17) *pillventris*, new species.
8. Arista thickened on proximal two-thirds, bare; third antennal segment yellow on basal half, five to six times longer than second; parafacial at narrowest part but slightly wider than third antennal segment; pollen on intermediate abdominal segments extending thinly to hind margin (Peru).  
(16) *peruana* (Townsend).
- Arista thickened at base, very slender on apical two-thirds, clothed with short hairs to tip; third antennal segment black, narrowed toward base, about two and one-half times length of second; intermediate abdominal segments with defined silvery bands on basal third (Central America, Vera Cruz)----- (15) *aldrichi*, new species.
9. Apical cell of wing closed and petiolate; outer vertical bristles absent----- 11.  
Apical cell open; outer verticals nearly half as long as inner pair----- 10.
10. Epaulets reddish yellow; arista thickened on proximal fourth, distinctly short haired to tip; mesonotum covered with thick lusterless yellowish gray pollen, the dark stripes very inconspicuous and visible only in a flat rear view; abdomen largely pollinose, third and fourth segments at most subshining on narrow hind margins----- (18) *apicalis*, new species.  
Epaulets black; arista thickened almost to middle, pubescent; mesonotum gray pollinose, the black stripes distinct, not interrupted at suture; last three abdominal segments shining black on apical half or more----- (19) *affinis*, new species.
11. Mesonotum subshining, lightly dusted with pollen, the dark stripes hardly apparent; arista thickened on basal fifth to fourth; abdomen black and shiny, basal fourth of segments 2 and 3 thinly gray pollinose at most----- (23) *petiolata*, new species.  
Mesonotum densely gray pollinose and vittate, the black stripes usually fused into a single broad pair, which extends to base of scutellum; arista thickened about to middle; last three abdominal segments conspicuously pollinose on basal



(6) *PARADIDYMA SETIGERA* (Coquillett)

*Admontia setigera* COQUILLET, Invertebrata Pacifica, vol. 1, p. 36, 1904.

*Phytoadmontia setigera* TOWNSEND, Proc. U. S. Nat. Mus., vol. 49, p. 626, 1916.

*Female*.—Closely resembles *P. obliqua*, from which it differs in the following characters: Front at extreme vertex 0.294 of the head width in one specimen; median stripe distinctly narrower than one parafrontal on entire length; outer verticals weakly developed; third antennal segment three times longer than second; cheek one-half the eye height. Thorax and scutellum densely gray pollinose; mesonotum marked with four black stripes, which are distinct behind suture; three sternopleural bristles. Abdomen subshining, the pollen gray and without definite pattern, in certain lights extending thinly to hind margin of last three segments, the first conspicuously pollinose above. Fore claws and pulvilli almost normal in size. Hind cross vein of wing not unusually oblique; last section of fifth vein one-third as long as preceding section; costal spine exceeding the length of small cross vein.

*Length*.—5.5 mm.

*Male*.—Unknown.

*Type*.—Female, in the United States National Museum, from California.

*Remarks*.—Redescribed from one female, East Verde River, Ariz., 4,500 feet; without collector's label.

Besides the type and the present specimen, kindly loaned me for study by Dr. J. M. Aldrich, no additional specimens have apparently been taken since the species was described 30 years ago.

(7) *PARADIDYMA OBLIQUA*, new species

*Female*.—Front at vertex 0.304 of the head width in one specimen measured; median stripe reddish brown, about equal the width of one parafrontal; ocellars small, proclinate; verticals broken off, but the scars indicating a good-sized inner pair; orbital bristles two, proclinate; frontals about five in number, extending about to middle of second antennal segment, uppermost bristle reclinate, rather short; parafrontals gray pollinose to vertex, almost devoid of hairs outside of frontal rows; face receding, moderately excavated, in profile concave above mouth, its ridges normally divergent, bearing only one or two bristly hairs next to vibrissae; the latter situated on oral margin but well above the lower edge of head; parafacials gray pollinose, bare outside of the main row of bristles, which extend along inner margin from lowest frontals to level with apex of third antennal segment; cheek sparsely haired on lower margin, gray pollinose, about two-fifths the eye height; antennae a little shorter than

face, third segment black, about as wide as parafacial below and only slightly more than twice the length of second which is yellow; arista blackish, thickened on about basal fourth, penultimate segment as wide as long; palpi pale yellow, slender; proboscis short, labella fleshy; eyes sparsely short haired; back of head gray pollinose, moderately clothed with pale hairs.

Thorax black, thinly gray pollinose; mesonotum with four black stripes obliterated behind suture where the surface is subshining in most views; scutellum black, almost shining but lightly dusted with uniform grayish pollen; chaetotaxy as in *validinervis*, but with only two sternopleural bristles; postscutellum normal; no infrascapular hairs; calypters white.

Abdomen black, rather broad and flat above; last three segments with silvery bands on basal fifth, the remainder of these segments including the first polished or shining; first segment without median marginals; second with one pair, small; third also with a median pair, a wide space intervening between these and the next ones situated near the sides of the segment; fourth bearing a row of rather strong discals besides a row of somewhat weaker marginal bristles; hairs on intermediate segments depressed.

Legs black, trochanters yellow, coxae less distinctly so; front tarsal segments not laterally compressed, the claws and pulvilli small but distinct.

Wings grayish hyaline; third vein bristly two-thirds the distance to small cross vein; hind cross vein unusually oblique to fourth, joining it nearer bend than small cross vein; apical section of fifth vein one-half the length of preceding section; fourth vein with a rounded obtuse stumpless bend, curving outward shortly beyond, thence almost straight to costa; apical cell very narrowly open shortly before extreme tip of wing; costal spine small.

*Length*.—4 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 44760.

*Remarks*.—Described from one female specimen in the United States National Museum, collected by W. Carter, labeled "*S. pestifer*, Salmon River Crossing, Idaho, August 31, 1927."

This species, like *P. setigera*, has almost normally developed fore tarsal claws and pulvilli, but differs in the more oblique hind cross vein and the extremely narrow pollen bands on last three abdominal segments. There are other minor differences.

(8) *PARADIDYMA NEOMEXICANA*, new species

*Male*.—Front before triangle 0.258 of the head width in the one specimen; parafrontals gray pollinose to vertex, clothed with moder-

ately long black hairs, which extend downward below base of antennae; frontals about six in number, descending almost to level with apex of second antennal segment, directed inward, the uppermost pair reclinate, not very long; ocellars strongly divergent, proclinate; orbitals absent; inner verticals strong, outer ones not developed; face gray pollinose, its ridges normally divergent downward, bare except a few bristly hairs above vibrissae, which are on a level with the protruding front edge of mouth; sides of face below base of third antennal segment without any hairs between the row of bristles and margin of eye; cheeks gray pollinose, sparsely haired below, about two-fifths the eye height; antennae black, third segment reddish near base, about four times the length of second; arista black, thickened to middle; palpi brown, bearing several long black hairs near tip; eyes distinctly hairy; back of head clothed with pale hairs.

Thorax and scutellum black, covered with dense gray pollen; mesonotum with four very distinct black stripes, outer pair interrupted at suture and stopping before base of scutellum; chaetotaxy as in *validinervis*, except that there are three pairs of well-developed acrostichal bristles before the suture; postscutellum normal, gray pollinose; one hair present on each side of postnotum beneath the calypters; the latter semitransparent, white.

Abdomen black, covered with gray changeable pollen, which in most views extends to the hind margins of last three segments; basal segment without median marginals; second with one pair; third bearing a marginal row, the intermediate bristles poorly developed; fourth with a discal and a marginal row of rather stout bristles; genital segments blackish, subshining.

Legs black; claws and pulvilli elongated; the latter dark or grayish in color.

Wings subhyaline; hind cross vein sinuous, oblique to fourth, joining it nearer bend than small cross vein; apical section of fifth vein one-half the length of preceding section; apical cell narrowly open well before tip of wing; third vein setulose as usual; costal spine developed; epaulets black.

*Female*.—Front at extreme vertex 0.291 of the head width (one specimen); two pairs of strong proclinate orbitals; outer verticals about half as large as inner pair; third antennal segment moderately wide to tip, about three and one-half times as long as second; fore tarsal segments normal, the claws and pulvilli distinctly developed.

*Length*.—Male, 7.5 mm; female, 8 mm.

*Type*.—Male, U.S.N.M. no. 44761.

*Remarks*.—Described from one male and one female, Las Vegas, N.Mex., July (Cockerell).

From the other forms having the hind cross vein retracted, the present species may be separated by the following characters: Male with three pairs of well-developed presutural acrostichals; female with distinct fore tarsal claws and pulvilli; and the abdomen more extensively pollinose in both sexes.

(9) *PARADIDYMA DERELICTA*, new species

*Male*.—Front narrowed before vertex, at narrowest part 0.238 of the head width in one specimen; parafrontals densely gray pollinose to vertex, sparsely haired outside of frontal rows; median stripe reddish brown, at antennae about as wide as one parafrontal, verticals one pair (inner) developed; frontals ordinary in size, uppermost bristle reclinate and hardly stouter than the preceding one; sides of face densely gray pollinose, bare outside the main row of bristles, which become longer and stouter downward; antennae black, third segment five times the length of second; arista thickened hardly to middle; palpi dark brown; cheek nearly one-half the eye height, thickly clothed with hairs on lower margin.

Thorax black, covered with gray pollen, which on the mesonotum has a brownish sheen in certain lights; dorsal vittae four, outer pair interrupted at the suture; scutellum black, grayish pollinose; calypters tawny.

Abdomen black; pollen on intermediate segments with a brownish tinge apparent in most views; narrow hind margin of third and apical half of fourth segment subshining; first segment without median marginals; second with one pair; third bearing a marginal row of about eight; fourth with a row of discals, which are obviously stouter than the marginals; genital segments black.

Legs black; pulvilli tawny.

Wings grayish hyaline; hind cross vein noticeably retracted and sinuous; last section of fifth vein one-half as long as the preceding section; third vein setulose almost to small cross vein; apical cell narrowly open, reaching costa well before extreme wing tip; costal spine developed; epaulets black.

*Length*.—7 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44762.

*Remarks*.—Described from one male in the United States National Museum taken at Mound Valley, Chihuahua, Mexico, August 23, 1909, by Dr. C. H. T. Townsend.

Differs from *P. validinervis*, which it closely resembles, in the absence of median marginals on first abdominal segment, and in having the hind cross vein of wing noticeably retracted. There are other minor differences.

(10) *PARADIDYMA CINERESCENS*, new species

*Male*.—Very closely resembles *P. derelicta*, from which it differs in the following characters: Front at narrowest part (before vertex) 0.263 of the head width in one specimen measured; second antennal segment distinctly longer than first and nearly one-fourth the length of third; cheeks clothed with sparse black hairs on lower half; palpi brownish black. Thorax and scutellum covered with dull cinereous pollen; postscutellum membranous above; calypters white. Abdomen subshining, lightly sprinkled with gray pollen, which in most views extends to the hind margins of last three segments. Pulvilli grayish, about as long as last tarsal segment.

*Length*.—6 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44763.

*Remarks*.—One male, Promontory Point, Utah, August 5, 1929 (G. F. Knowlton).

The species has a general pale-gray appearance, in contrast with the decidedly blacker aspect of *P. derelicta*, to which it is closely allied. The slight structural differences are mentioned in the key.

(11) *PARADIDYMA RETRACTA*, new species

Hind cross vein noticeably retracted; last section of fifth vein more than half the length of preceding; apical cell open; sternopleurals two; last three abdominal segments shining black on apical three-fourths or more.

*Male*.—Front at vertex 0.228 of the head width in one specimen measured, hardly widened to middle, and not very prominent at antennae; cheeks, face, and sides of front gray pollinose; median stripe brownish, as wide as one parafrontal on entire length; ocellars proclinate; inner verticals developed; frontals extending about to apex of second antennal segment, uppermost pair rather weak, reclinate; antennae nearly as long as face, black, second segment reddish, one-fourth the length of third; arista blackish, thickened on proximal two-fifths; facial ridges strongly diverging downward, bare except a few hairs next to vibrissae, which are situated on oral margin; parafacials bare outside of the main row of bristles; cheeks sparsely black haired below, about two-fifths the eye height; palpi pale yellow; eyes hairy; beard white.

Thorax black, gray pollinose; mesonotum marked with four distinct black vittae; scutellum black, subshining, lightly dusted with changeable gray pollen; infrascapular hairs absent; calypters semi-transparent, white; postscutellum normally developed.

Abdomen mostly shining black, with silvery basal bands on last three segments, which in a favorable angle extend at most over the

basal third of intermediate segments; first segment bearing a very slender or hairlike pair of median marginals; second with a well-developed pair; third bearing a marginal row of about six with a wide space between the median pair and the lateral one; fourth with a row of strong discals besides the usual marginal row; genital segments shining black, retracted; fifth sternite black, the lobes prominent, narrowly and deeply incised.

Legs slender, black; claws and pulvilli nearly as long as the apical tarsal segment.

Wings subhyaline; hind cross vein very oblique to fourth, which it joins almost midway between bend and small cross vein; apical cell narrowly open well before the tip of wing; third vein setulose three-fourths the distance to small cross vein; costal spine small; epaulets black.

*Length*.—6 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44764.

*Remarks*.—Described from one male specimen taken at Smithfield, Utah, August 24, 1925, by G. F. Knowlton.

The narrower front, retracted hind cross vein, two sternopleural bristles, and the more defined and narrower pollen bands on last three abdominal segments distinguish the species from *affinis*, described herein. The two species agree in most other essential characters.

(12) *PARADIDYMA CRASSISETA*, new species

*Male*.—Front at vertex 0.23 and 0.21 of the head width in two specimens, very prominent at antennae; face strongly receding, its ridges rather flattened below, bearing bristly hairs and one or two strong macrochaetae next to vibrissae; parafrontals black, covered with reflecting grayish pollen, narrow on upper part behind middle; median stripe red, wider than one parafrontal except at antennae; frontals six to eight in number, directed inward, the uppermost nearly erect, not longer than preceding pair; orbitals absent; inner verticals strong, outer ones not developed; ocellars ordinary in size, proclinate; antennae black, about as long as face; first segment extending considerably above the front and as long as the second; third segment unusually broad to tip and about equal the width of parafacial at narrowest part, six to seven times as long as the second segment; arista black, thickened on proximal two-thirds, second segment short; parafacials black, the pollen dark gray with a distinct luster, clothed with black hairs outside the row of bristles, which become successively longer and stronger downward; palpi dark brown; cheek one-half the eye height; eyes distinctly hairy; beard white.

Thorax and scutellum black, gray pollinose; mesonotum marked with four black stripes in front and five behind suture, outer pair stopping before base of scutellum; infrasquamal hairs present, calypters white.

Abdomen black, all segments with gray pollen, which in some views extends thinly past the middle of the last three; basal segments each with a pair of median marginals (smaller on the first); third with a marginal row of 10 to 12; fourth bearing a complete row of discals as large as those in the marginal row; genital segments black, retracted.

Legs black, reddish near base; claws and pulvilli longer than apical tarsal segment; hind tibia with a row of uneven wide-spaced bristles on outer posterior edge.

Wings with a brownish tinge on the anterior margin, small cross vein infuscated; venation normal; third vein setulose two-thirds the distance to small cross vein; apical cell open well before exact wing tip; epaulets blackish; costal spine ordinary in size.

*Length*.—9 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44765.

*Remarks*.—Described from two male specimens in the United States National Museum: One (the type) labeled Sanchez, Chihuahua, Mexico, September 2, 1909 (C. H. T. Townsend); the other, Las Vegas, New Mexico, August 19, 1901 (H. S. Barber).

The prominent front, more strongly receding face, longer and broader third antennal segment, and haired parafacials readily separate the species from *P. derelicta*, to which it is closely related. Another difference is the presence of median marginals on the first abdominal segment.

(13) *PARADIDYMA ARISTALIS*, new species

Arista densely pubescent; parafacial bristles uniform in length downward, smaller than usual; sides of face cinereous, with black hairs extending below middle outside of the main row of bristles; mesonotum with four black stripes in front and five behind suture.

*Male*.—Front at vertex 0.26 of the head width (one specimen), rather prominent at antennae; parafrontals cinereous pollinose to vertex, rather sparsely clothed with short black hairs and considerably widened before middle; median stripe reddish brown, slightly narrowed behind; inner verticals large; ocellars proclinate; orbitals absent; frontals about six in the row, the lowermost nearly on level with apex of second antennal segment; face receding, moderately deep, and concave above the mouth; vibrissae large, on level with oral margin; facial ridges divergent downward, bearing a few bristly

hairs on lower extremity; cheek bare above the lower margin, gray pollinose, about two-fifths the eye height; antennae as long as face, first segment rather prominently elevated above the front, third segment about five times longer than second; arista black, thickened nearly to middle, proximal segments short but distinct; palpi slender, pale yellow; beard white; eyes distinctly hairy.

Thorax and scutellum black, densely gray pollinose; three pairs of acrostichal bristles behind the suture, the median ones very weak or hairlike; other details of chaetotaxy as in *validinervis*; infra-squamal hairs present; postscutellum gray pollinose, membranous above; calypters semitransparent, white.

Abdomen black, wholly gray pollinose; first segment without median marginals; second with a stout closely spaced pair; third with a marginal row of about 10; fourth bearing a complete row of good-sized discals, besides a row of still larger marginals; genital segments reddish black, lightly pollinose, fifth sternite deeply divided, the lobes blackish, clothed with fine hairs.

Legs mostly black, the basal segments and the hind tibiae obviously reddish (front pair missing); claws and pulvilli elongate.

Wings subhyaline; venation normal; apical cell open well before tip of wing; costal spine large; epaulets red.

*Length*.—8.5 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44766.

*Remarks*.—Described from one male labeled "Animas Park, N.Mex., 6,500 feet (Townsend)."

#### (14) PARADIDYMA APERTA Brauer and Bergenstamm

*Paradidyma aperta* BRAUER and BERGENSTAMM, Die Zweiflügler des kaiserlichen Museums zu Wien, no. 6, p. 187, 1893.

*Microchira mexicana* BRAUER and BERGENSTAMM, Ibid., p. 188.

Readily distinguished from all other known species by the golden pollen on the head. I have not seen any male specimens.

*Female*.—Front at extreme vertex 0.312 of the head width (one specimen); pollen deep golden-yellow on parafrontals, parafacials, cheeks, and posterior orbits; face yellowish gray; outer verticals about half the size of inner ones; orbitals, two pairs; ocellars proclinate; frontals extending to apex of second antennal segment, directed inward, except the uppermost, which is reclinate; parafacial on narrowest part about one-half the width of facial depression, bearing a row of rather weak bristles and with black hairs on entire length outside the main row; vibrissae situated on front edge of mouth; facial ridges with one or two bristles and fine hairs next to vibrissae; cheek fully one-half the eye height; palpi yellow;



antennae shorter than face, mostly black, third segment rather slender and about two and one-half times the length of second; arista black, thickened on basal fourth, clothed with short hairs, penultimate segment short; eyes distinctly hairy; back of head gray pollinose, moderately pale haired below.

Thorax and scutellum black, gray pollinose; mesonotum with four distinct black stripes before the suture and five behind, the outer pair not interrupted at middle and stopping well in front of scutellum; acrostichals, 3, 3 (first two behind suture small); postscutellum normally developed, gray pollinose; infrasquamal hairs present; calypters white with yellow margins.

Abdomen broadly ovate, black, wholly covered with thick yellowish-gray pollen; first segment without median marginals; second with a closely spaced pair; third bearing a marginal row of about eight; fourth with a discal row well behind the middle besides a marginal row of weaker bristles.

Legs black, trochanters red; front legs with the tarsal segments laterally compressed and swollen, claws and pulvilli minute; mid tibia with one strong bristle on outer front side near middle; hind tibia with a scattering row of uneven bristles on outer posterior edge.

Wings grayish hyaline; venation normal; third vein bristly two-thirds the distance to small cross vein; apical cell open far before tip of wing; costal spine long; epaulets red.

*Length*.—10 mm.

*Remarks*.—Redescribed from one female specimen in the United States National Museum, Atzacopozalco, D. F., Mexico, August 31, 1922 (E. G. Smyth).

(15) *PARADIDYMA ALDRICHI*, new species

*Female*.—Front at extreme vertex 0.25 to 0.27 of the head width in three specimens measured; parafrontals black, thinly gray pollinose; median stripe reddish brown, about equal the width of one parafrontal on entire length; the usual two proclinate orbitals present; ocellars rather weak, proclinate; inner verticals large, outer ones not developed; frontals about five in the row, descending to middle of second antennal segment, uppermost one stouter and reclinate; antennae somewhat shorter than face, third segment black, rather narrow at base and about two and one-half times longer than the second, which is largely yellow; arista brown, thickened at base and very slender on apical two-thirds, clothed with short hairs to tip, second segment short; face moderately excavated, hardly receding but concave above mouth in profile, its ridges bearing a few bristly hairs next to vibrissae, which are situated on oral

margin; parafacials blackish, covered with feebly shining gray pollen, bare below arista, except a row of weak bristles along inner margin which are reduced in size to small hairs on the upper part; palpi yellow, slender to tip; cheek one-third to two-fifths the eye height; eyes sparsely short haired; back of head gray pollinose, moderately clothed with whitish hairs.

Thorax black, gray pollinose; mesonotum with four black stripes, which are sometimes indistinctly separated behind the suture; scutellum black, lightly sprinkled with changeable gray pollen, post-scutellum normal, thinly pollinose; infrasquamal hairs absent in two specimens and three hairs present in the other; calypters pale yellowish white.

Abdomen shining black; intermediate segments with silvery bands on basal third, the fourth thinly pollinose almost to apex; first segment without median marginal bristles; second with one pair; third and fourth each bearing a marginal row; fourth without discals, the broad basal margin above destitute of hairs.

Legs black; front tarsi compressed and swollen, the claws and pulvilli very minute.

Wings brown, paler on the posterior margin; apical cell open shortly before wing tip; venation normal; third vein setulose half to three-fourths the distance to small cross vein; costal spine longer than small cross vein; epaulets black.

*Length*.—7 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 44767.

*Remarks*.—Described from three female specimens in the United States National Museum as follows: 1 (the type), taken at Ingenio R.R. Station, Guatemala, April 28, 1926, by Dr. J. M. Aldrich, in whose honor the species is named; 1, labeled San Rafael, Vera Cruz (C. H. T. Townsend), and the other, Higuito, San Mateo, Costa Rica (Pablo Schild).

The species has the eyes less distinctly haired and smaller parafacial bristles than any other member of the genus. It is provisionally included here. The accumulation of better preserved specimens, including the male sex, seems necessary to decide the question of proper generic allocation. The relationship with *Ceratomyiella* seems close, but the type species of that genus has the eyes entirely bare.

(16) *PARADIDYMA PERUANA* (Townsend)

*Diaphoropeza peruana* TOWNSEND, PROC. U. S. Nat. Mus., vol. 43, p. 308, 1912.

Very similar to *P. singularis*, from which it differs in the following characters:

*Female*.—Front rather narrow, at extreme vertex 0.26 of the head width (one specimen); parafacial at narrowest about as wide as third antennal segment; cheek barely one-third the eye height. Infrascapular hairs present; calypters with rims pale tawny. Abdomen without defined silvery basal bands on last three segments; first thinly gray pollinose above and on sides; intermediate segments with the pollen extending thinly beyond the middle when viewed from behind; anal segment almost entirely gray pollinose, without discal bristles; venter largely covered with gray pollen. Legs brownish black. Wings with a distinctly yellow tinge on costal margin and along the veins, hind margins grayish hyaline; apical cell closed at costa, not petiolate; costal spine about as long as small cross vein; epaulets reddish black.

*Length*.—7.5 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 15147.

*Remarks*.—Redescribed from one paratype female from Sullana, Peru, October 1, 1910, TD 3942 (C. H. T. Townsend). In the United States National Museum there are three additional female type specimens from the same locality and one female from Piura, Peru, all collected by Dr. C. H. T. Townsend.

The narrower cheeks and parafacials and the absence of discal bristles on the fourth abdominal segment readily separate the species from *P. singularis*.

(17) *PARADIDYMA PILIVENTRIS*, new species

Distinguished from all others of this group by the presence of pale hairs on venter of abdomen.

*Female*.—Front at vertex 0.29 and 0.27 of the head width in the two specimens; parafrontals black, thinly gray pollinose, with more numerous black hairs on the lower part extending on the parafacials about to level with arista; outer verticals not developed; ocellars proclinate; orbitals two proclinate pairs; frontals about six in number, distinctly larger than parafacial bristles, uppermost pair rather stout and reclinate, the others directed inward descending below middle of second antennal segment; face blackish, gray pollinose, moderately receding and concave above mouth in profile; facial ridges not very prominent, bearing bristly hairs on about the lowest fourth; parafacials largely black, covered with satiny gray pollen, a row of bristles along the reddish inner margin, outside of these bare on lower half; antennae shorter than face, wholly black, third segment narrowed toward base and about two and one-half times the length of second; arista black, thickened on proximal fourth, basal segments short; vibrissae near the front edge of the mouth; cheeks two-fifths the eye height; eyes distinctly hairy; palpi black, bearing several

long pale hairs on under side near the tip; back of head blackish, thinly gray pollinose, rather sparsely clothed with pale hairs.

Thorax and scutellum black, dusted with gray pollen; mesonotum marked with four black vittae, outer pair not interrupted at suture; chaetotaxy as in *validinervis*; infrascapular hairs absent; postscutellum normal; calypters pale yellowish white.

Abdomen black and shiny; last three segments with dense grayish-white pollen bands, which are wider on the sides of the intermediate segments and narrowed at the middle above, especially on the second where the pollen is confined on the basal margin; first segment without median marginals; second with one pair; third and fourth each bearing a marginal row of about 10; fourth segment without discal bristles; venter pale haired.

Legs black, basal segments reddish; front tarsal segments swollen, the claws and pulvilli minute or atrophied; hind tibia with three large and several small bristles on outer posterior edge.

Wings infuscated, a little paler along the hind border; venation normal; third vein with hairs extending almost to small cross vein; apical cell open shortly before wing tip; costal spine strong; epaulets black.

*Length*.—7 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 44768.

*Remarks*.—Described from two females in the United States National Museum, collected at Huariaca, Peru, December, 1921, by Dr. C. H. T. Townsend.

(18) *PARADIDYMA APICALIS*, new species

*Male*.—Front at vertex 0.258 of the head width (average of five: 0.24; 0.26; 0.26; 0.27; 0.26), hardly wider to middle, thence diverging to antennae where it is rather prominent in profile; median stripe reddish brown, nearly as wide as one parafrontal on most of its length; ocellars present; verticals one pair (inner) developed; orbitals absent; frontals five or six in number, the rows moderately divergent beneath antennae extending to apex of second segment, uppermost bristle stouter, reclinate; parafrontals covered with dull gray pollen to vertex, moderately clothed with rather coarse black hairs; face receding and concave above the mouth in profile, its ridges not very prominent, haired on lower fourth or less; parafacials densely gray pollinose, a row of bristles along the inner margin becoming longer and stronger downward, the largest approximating the frontals in size, bare outside the main row of bristles below level of arista; vibrissae situated on oral margin; antennae about as long as face, basal segments subequal in length,

third black, five or six times longer than second which is largely yellow; arista blackish, finely pubescent, thickened on proximal two-fifths, basal segments short; palpi slender, pale yellow, bearing a few long black hairs beneath on apical half; cheek bare above lower margin, gray pollinose, clothed with pale hairs; eyes distinctly hairy.

Thorax and scutellum black, covered with thick gray pollen; mesonotum with four narrow dark stripes, often poorly defined, interrupted at suture and stopping far before base of scutellum; two or three acrostichal bristles usually developed behind the suture, other details of chaetotaxy as in *validinervis*; postscutellum thinly pollinose and membranous above; infrasquamal hairs present; calypters semitransparent, white with a tawny tinge.

Abdomen black, largely gray pollinose; hind margins of last three segments black and subshining when viewed from above, but pollinose or subpollinose in most other views, first segment with conspicuous pollen on the sides above; one pair of median marginal bristles present on first and second segments, the third and fourth each with a marginal row, no discals on dorsal surface of fourth segment; genital segments small, black, retracted; inner forceps united, slender, clothed with brownish hairs behind near base, flattened and shining beyond middle, apex minutely notched; outer forceps shorter than inner ones, tapering uniformly to a blunt tip, tinged with yellow; penis simple, short, blackish, apex bearing a short pale membrane.

Legs black, basal segments and knees yellowish; mid tibia with a whorl of three bristles near middle, the one on outer front side stout; hind tibia with a scattering row of irregular bristles on outer posterior edge; claws and pulvilli elongate.

Wings subhyaline; veins yellow, bare except third, which has hairs extending almost to small cross vein; fourth vein with a rounded almost rectangular stumpless bend, beyond rather deeply concave to costa; last section of fifth vein about one-fourth as long as preceding section; apical cell open well before the wing tip; costal spine strong; epaulets red.

*Female*.—Front at vertex 0.282 of the head width (average of five: 0.28; 0.28; 0.28; 0.31; 0.26); pollen on parafrontals, mesonotum and abdomen with a distinct pale brassy tinge; outer verticals developed, orbitals two pairs; antennae shorter than face, third segment slender, yellow at base, about four times the length of second; arista short haired to the tip; first abdominal segment without median marginals, the fourth with discals above; fore tarsal segments compressed and swollen, claws and pulvilli atrophied.

*Length*.—6 to 8 mm.

*Type*.—Male, U.S.N.M. no. 44769, from College Station, Tex.

*Remarks*.—Described from 14 males and 11 females in my collection. All taken at College Station, Tex., September–November 1920–1933 (H. J. Reinhard), and one male from Hidalgo County, Tex., May 18, 1932 (S. W. Clark). In the United States National Museum, one female from La Providencia, Obispo, Guatemala (C. M. Rouillard).

(19) *PARADIDYMA AFFINIS*, new species

*Male*.—Front at vertex 0.288 of the head width (average of five: 0.29; 0.28; 0.29; 0.29; 0.29), hardly widening to middle thence rapidly so to antennae where it is moderately prominent; parafrontals gray pollinose to vertex, moderately clothed with rather coarse black hairs outside the frontal bristles; median stripe red, occupying about one-third the frontal width; inner verticals large, outer pair not developed; orbitals absent; frontal bristles extending below middle of second antennal segment, uppermost one reclinate; ocellars present, proclinate; antennae about as long as face, basal segments subequal in length, third segment black, six or seven times longer than second which is largely yellow; arista black, thickened about to middle, finely pubescent, second segment short; face gray pollinose, moderately excavated, receding with the lower border slightly prominent between vibrissae; facial ridges weakly divergent downward, bearing a few bristly hairs next to vibrissae, which are situated on the oral margin; palpi slender, pale yellow, with several long black hairs on lower edge beyond the middle; parafacial gray pollinose, bare except a row of bristles along the inner margin, those in lower part of row approximating the frontals in size; cheek reddish in ground color, thinly gray pollinose and bare above, about two-fifths the eye height; eyes distinctly haired; back of head densely gray pollinose and thickly clothed with pale or whitish hairs.

Thorax black, gray pollinose; mesonotum marked with four narrow black stripes, which are not very conspicuous especially behind the suture; scutellum black, covered with dull gray pollen, which is thinner on middle of disk; chaetotaxy as in *validinervis* but with three postsutural acrostichals usually present; postscutellum normal, thinly pollinose; sides of postnotum beneath calypters bearing a tuft of small black hairs; calypters semitransparent, white.

Abdomen black, dusted with gray pollen, which in certain views extends thinly behind the middle on the intermediate segments; viewed from above the first segment pollinose on sides and the three following ones shining black on posterior third to half; first segment without median marginals; second with one pair; third bearing a marginal row of 10 to 12; fourth with a discal and a marginal

row of stronger bristles; genitalia as in *P. singularis*, but the outer forceps more broadly rounded at the apex.

Legs rather slender, black; claws and pulvilli elongated.

Wings grayish hyaline; venation bare except third vein, which is setulose almost to small cross vein; fourth vein with a rounded stumpless bend and broadly concave beyond to costa; last section of fifth vein about one-fourth the length of preceding section; apical cell narrowly open far before wing tip; costal spine strong; epaulets black.

*Female*.—Front at vertex 0.288 of the head width (five measured as follows: 0.3; 0.27; 0.29; 0.28; 0.3); outer verticals developed but smaller than inner ones; orbitals two proclinate pairs; antennae shorter than face, third segment slender, four to five times the length of second; first abdominal segment usually without median marginal bristles (two specimens with a pair present); front tarsi laterally compressed and swollen, the claws and pulvilli minute or atrophied.

*Length*.—5.5 to 9.5 mm.

*Type*.—Male, U.S.N.M. no. 44770, from College Station, Tex.

*Remarks*.—Described from 50 specimens. In the United States National Museum: 2 males, Knoxville, Tenn., May 25 (J. M. Aldrich); 1 male, Birmingham, Ala., June 4, 1917 (J. M. Aldrich); 1 female, Lafayette, Ind., September 12, 1918 (J. M. Aldrich); 1 female, Riley County, Kans., May 29 (Popenoe); 1 female, Manhattan, Kans., May 30, 1928 (R. C. Smith); 1 female, labeled "Ga." without additional data; 1 male and 1 female, Clemson College, S.C., October 10, 1908 (C. H. T. Townsend); 1 female, Holly Springs, Miss., September 7, 1890 (F. W. Mally); 1 male, Miami, Fla., September 6 (C. H. T. Townsend); 1 female, Washington, D.C., September 18, 1921 (J. M. Aldrich); 1 female, Rock Creek, D.C., flowers chrysanthemum, May 30, 1917 (C. H. T. Townsend); 1 male, Eastern Branch near Bennings, D.C., August 29, 1915 (W. L. McAtee); 1 male, Washington, D.C., June 27 (Townsend); 1 female, Washington, D.C., October 2, 1917 (W. L. McAtee); 1 female, Anacostia, D.C., September 24, 1914 (R. C. Shannon); 1 female, at light, Plummers Island, Md., September 2, 1914 (R. C. Shannon); 1 female, Chesapeake Beach, Md., October 14, 1926 (J. M. Aldrich); 1 female, Arlington, Va., October 6, 1913 (R. H. Hutchison); 1 male, Lincoln, Nebr., July 7, 1922 (O. C. Bradbury); 1 female, Marfa, Tex., June 13, 1917 (J. M. Aldrich); 1 female, Raleigh, N.C. (C. S. Brimley). In the Kansas University Museum: 1 male, Las Cruces, N.Mex., September 25, no collector's label. In my collection: 9 males and 16 females, College Station, Tex., April to October, 1917–1930 (H. J. Reinhard). In the collection of D. G. Hall, 1 female, Manhattan, Kans., May 10, 1929 (D. G. Hall).

In the material examined I have noted but one specimen (female) having the first posterior cell closed and short petiolate. In *singularis* the first posterior cell is invariably closed and usually short petiolate. Other differences may be noted in the present species: Four narrow thoracic stripes; fourth abdominal segment with discals above in male; outer verticals present in female.

(20) *PARADIDYMA VALIDINERVIS* (Van der Wulp)

*Didyma validinervis* VAN DER WULF, Biologia Centrali-Americana, Diptera, vol. 2, p. 164, 1890.

*Paradidyma validinervis* BRAUER and BERGENSTAMM, Die Zweiflügler des kaiserlichen Museums zu Wien, no. 5, p. 404, 1891; no. 6, p. 127, 1893.

Besides the characters mentioned in the generic description, the type species has the following additional characters:

*Male*.—Front narrowed before vertex, at narrowest part 0.22 of the head width in one specimen; parafrontals covered with dense gray pollen to vertex, sparsely clothed with hairs outside of frontal rows; median stripe reddish brown, at middle wider than one parafrontal; inner verticals developed; frontals ordinary in size, the uppermost bristle subreclinate and hardly stouter than the preceding one; parafacials densely gray pollinose, bare below level of arista outside of the main bristles, which increase in size downward in the row; antennae black, third segment about four times the length of second; arista pubescent, thickened about on proximal half; palpi dark brown; cheek clothed with black hairs on lower margin, about two-fifths the eye height; eyes hairy.

Thorax black, gray pollinose; mesonotum marked with four black stripes, outer pair interrupted at suture; scutellum black, thinly gray pollinose; calypters whitish, the hind lobe translucent and with a slight brownish tinge.

Abdomen black; segments two to four shining beyond the basal silvery band, only the second showing thin pollen more extensively in a flat rear view; basal segments each with a pair of median marginals; third bearing a marginal row of six, large; fourth with a row of six discals, which are slightly stouter than the marginals; genital segments black.

Legs black; claws and pulvilli elongate.

Wings grayish hyaline; first vein bare, third setulose almost to small cross vein; apical cell narrowly open; last section of fifth vein less than half as long as preceding section; costal spine developed.

*Length*.—7 mm.

*Remarks*.—Redescribed from one cotype male specimen in the United States National Museum from Guerrero, Mexico. I have not seen any specimens of the female.



(21) *PARADIDYMA BRASILIANA*, new species

*Male*.—Front moderately wide, at vertex 0.29 of the head width in one specimen; parafrontals covered with gray pollen tinged with yellow along the inner margins; parafacials, cheeks, and posterior orbits cinereous; third antennal segment largely black, the base yellow to the insertion of the arista. Sides of postnotum beneath calypters with a few small inconspicuous hairs. Abdomen slender, tapering to a rather narrow apex; first segment conspicuously gray pollinose on the sides above, second almost entirely covered with changeable gray pollen, third and fourth shining black on apical third to half; genital segments black, small and retracted. Otherwise as in *P. singularis*.

*Length*.—7 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 44771.

*Remarks*.—Described from one male specimen collected at Itaquaquecetuba, Sao Paulo, Brazil, September 26, by Dr. C. H. T. Townsend.

I am unable to note any structural differences between the present species and *P. singularis*; both have the third antennal segment strikingly elongated with the anterior margin concave below the insertion of the arista. The rather slight characters separating the species are mentioned above and in the key. A second closely related species is *P. peruana*, known only in the female; it differs from *brasiliانا* in having the cheeks distinctly narrower, the wings and calypters obviously tinged with yellow, and apical cell barely closed at costa.

(22) *PARADIDYMA SINGULARIS* (Townsend)

*Atrophopoda singularis* TOWNSEND, Trans. Amer. Ent. Soc., vol. 18, p. 373, 1891.

*Lachnomma magnicornis* TOWNSEND, Trans. Amer. Ent. Soc., vol. 19, p. 103, 1892.

*Paradidyma singularis* COQUILLETT, Revision of the Tachinidae of America, p. 126, 1897.—ALDRICH, Catalogue of North American Diptera, p. 174, 1905.

*Male*.—Front at vertex 0.306 of the head width (five measured as follows: 0.31; 0.31; 0.3; 0.3; 0.31), rather prominent at antennae; parafrontals, parafacials, and cheeks cinereous pollinose; face long and deeply excavated, its ridges weakly divergent downward, bearing a few bristles and hairs on lower extremity; antennae strikingly elongate, first segment longer than second and extending considerably above level of the front, third segment black, about equal the length of face with the front edge concave below insertion of arista; the latter thickened on proximal three-fourths; cheek two-fifths the eye height; parafacial bare outside the main row of bristles; palpi yellow; eyes distinctly hairy.

Thorax black; mesonotum densely gray pollinose, the black stripes usually fused into a single broad pair, which extends to base of scutellum; chaetotaxy as in *validinervis*; sides of postnotum beneath calypters usually bare but sometimes with a few small hairs present; calypters white.

Abdomen black; last three segments with silvery bands on basal third. remainder of these segments including the first polished or shining; basal segment without median marginal bristles; second with one pair; third and fourth each with a marginal row, the fourth occasionally with one or two discals on the sides but none at middle above; genital segments blackish, retracted; inner forceps black, with a slight median keel behind, moderately broad at base, the apical half narrowed terminating in an acutely tipped shining beak; outer forceps yellow, slightly shorter than inner ones, the sides bulged and clothed with short brownish hairs, tips blunt; fifth sternite with a narrow deep incision, the lobes black.

Legs black; claws and pulvilli elongate.

Wings grayish hyaline; third vein with hairs extending almost to small cross vein; last section of fifth vein one-third the length of preceding section; apical cell closed and usually short petiolate; costal spine well developed.

*Female*.—Front at vertex 0.328 of the head width (average of five: 0.35; 0.32; 0.35; 0.31; 0.31); the usual two pairs of proclinate orbitals present; outer verticals not developed; antennae shorter than face, third segment slender, about one-half as wide as parafacial and four or five times longer than second; cheek two-fifths the eye height; fourth abdominal segment with a row of discals behind the middle above; fore tarsi compressed, the claws and pulvilli atrophied.

*Length*.—5.5 to 8.5 mm.

*Remarks*.—Redescribed from a long series of both sexes from all sections of the United States, including the type male of *Lachnomma magnicornis* Townsend, in the Kansas University Museum.

A common North American species described from Carlinville, Ill. Readily distinguished from most other members of the genus by the two broad black thoracic stripes, which in well-preserved specimens are sharply contrasted on entire length by a median and lateral pale gray pollen bands. *Catemophrys sequens* Townsend presents about the same general appearance but can readily be separated by its bare eyes and parafacials.

(23) *PARADIDYMA PETIOLATA*, new species

Mesonotum subshining, the vittae poorly defined; arista thickened on proximal half or less; apical cell closed, the petiole about twice the length of small cross vein.

*Male*.—Front 0.252 of the head width (average of five: 0.26; 0.25; 0.25; 0.25; 0.25), hardly widening to middle, thence rapidly so downward; parafrontals thinly gray pollinose often blackish before vertex, clothed with sparse short hairs; median stripe reddish brown, hardly narrowed behind and extending on each side of triangle to vertex; inner verticals moderately strong, directed posteriorly, outer pair vestigial; ocellar bristles small, proclinate, divergent; orbitals absent; frontal bristles about five in each row, descending to level with apex of second antennal segment, uppermost pair reclinate, the others directed inward; face rather long and receding, deeply excavated, ground color black, gray pollinose, its ridges bare except a few bristly hairs above vibrissae; parafacial covered with shining gray or almost silvery pollen, bearing a row of bristles along the inner margin which become longer and stouter downward; vibrissae situated on level with front edge of mouth; antennae as long as face; third segment black, with the anterior edge practically straight, about seven times the length of second; basal segments tinged with red, the first longer than second and extending well above the level of the front; arista slightly shorter than third antennal segment, black, thickened on proximal two-fifths, basal segments short but distinct; cheek about two-fifths the eye height; proboscis short, labella fleshy; palpi slender, hardly thickened apically, yellow; eyes distinctly hairy; beard white.

Thorax black, thinly dusted with gray pollen; mesonotum subshining, the vittae poorly defined; chaetotaxy as in *validinervis*, except that there are usually three pairs of acrostichals before the suture; scutellum black, subshining; infrasquamal hairs present; postscutellum normally developed; calypters white.

Abdomen shining black, with narrow silvery basal bands on intermediate segments, the fourth faintly pruinose at most; first segment without median marginals; second with a single pair; third and fourth with marginal rows, the latter also with discals at the sides but none on the middle above; genital segments black; inner forceps united, flat behind, tapering from base to an acute tip; outer forceps yellowish, shorter than inner pair, tapering outward, the tips rather narrow and darker.

Legs black; claws and pulvilli elongate; wings subhyaline; veins bare except third, which is setulose almost to small cross vein; last section of fifth vein at most one-third the length of preceding section; apical cell closed, with petiole longer than small cross vein; costal spine small.

*Female*.—Front at vertex 0.252 of the head width (average of five: 0.25; 0.25; 0.26; 0.25; 0.25), widening gradually to base of antennae; parafrontals blackish, subshining; orbitals two pairs, pro-

clinate; outer verticals not developed; third antennal segment slender, yellow at base, four to five times as long as second; abdomen mostly polished black, intermediate segments silvery on the narrow basal margin, fourth with discal bristles above; fore tarsal segments compressed and swollen, the claws and pulvilli minute.

*Length*.—5 to 6.5 mm.

*Type*.—Male, U.S.N.M. no. 44772.

*Remarks*.—Described from 6 males and 11 females. In the United States National Museum: 2 males and 3 females (including the type), Lafayette, Ind., August and September 1917–1921 (J. M. Aldrich); 2 males and 4 females, Plummers Island, Md., September 24, 1902 (Barber and Schwarz), August 1903 (A. Busck), August 3, 1912 (J. R. Malloch), 3 females labeled "at light", September 7, 1912, without collector's label; 1 female, Chesapeake Beach, Md., September 19, 1915 (W. L. McAtee); 1 male, Dead Run, Fairfax County, Va., September 30, 1915 (R. C. Shannon); 2 females, Difficult Run, Va., September 19, 1916, and October 28, 1917 (W. L. McAtee). In the Kansas University Museum: 1 pair labeled "Ills. Forbes."

The species is closely related to *P. singularis*, from which it may be readily separated by the shining black mesonotum; longer petiole of the apical cell; and narrower front in both sexes.

(24) *PARADIDYMA ARMATA* (Townsend)

*Lachnommopsis armata* TOWNSEND, Proc. U.S. Nat. Mus., vol. 49, p. 421, 1915.

Front uncommonly broad to vertex and orbitals present in the male sex; parafacial bristles about uniform in length throughout the row; abdomen densely gray pollinose.

*Male*.—Front at extreme vertex 0.33 and 0.35 of the head width in two specimens, not much wider at base of antennae; parafrontals gray pollinose to vertex, sparsely haired outside of frontal rows; median stripe red, narrower than one parafrontal on entire length; inner and outer verticals developed; orbitals one pair, proclinate; ocellars present; frontals extending to apex of second antennal segment, the uppermost stronger and reclinate; face rather strongly receding and concave above the mouth in profile view, not very deep; facial ridges divergent below and haired on lower fourth or less; parafacials gray pollinose, a row of bristles along the inner margin that are noticeably smaller than the lowermost frontals, bare outside the main rows below base of third antennal segment; vibrissae on level with front edge of mouth; antennae slightly shorter than face, third segment black, about four times length of second which is mostly yellow and distinctly longer than the first; arista thickened to apical fourth, basal segments short; cheek fully one-third the eye height; palpi slender, pale yellow; eyes distinctly hairy.

Thorax and scutellum black, gray pollinose; mesonotum marked with four narrow black stripes, outer ones interrupted at suture and stopping before base of scutellum; chaetotaxy as in *validinervis*; postscutellum gray pollinose, pale membranous above; infrascapular hairs present; calypters tawny, paler at middle.

Abdomen black, wholly covered with gray pollen; first segment without median marginals; second with one pair; third and fourth each with a marginal row; no discals on anal segment; genital segments reddish black retracted; fifth sternite prominent, narrowly and deeply incised, the lobes pale yellow.

Legs black, trochanters yellow, coxae less distinctly so; claws and pulvilli shorter than the apical tarsal segment.

Wings subhyaline; venation normal; third vein haired about halfway to small cross vein; apical cell open a little before the exact tip of wing; costal spine developed; epaulets red.

*Female*.—Front at vertex 0.349 of the head width (one specimen); fore tarsal segments compressed, the claws and pulvilli minute or atrophied, otherwise very similar to male.

*Length*.—6 mm.

*Type*.—Male, U.S.N.M. no. 19442.

*Remarks*.—Redescribed from three specimens in the United States National Museum. Two paratypes (male and female), Chosica, Peru, May 25, 1913 (C. H. T. Townsend), and one male, Matucana, Peru, April 22, 1914 (C. H. T. Townsend).

There appear to be no characters of generic importance, common to both sexes, that distinguish the species from *Paradidyma*. The secondary sexual characters in the male, viz, the wide front and presence of orbital bristles, at once separate it from all other known forms. The female, however, agrees in the essential characters of the present genus. As usual the front tarsi are compressed and swollen, with the claws and pulvilli minute or atrophied.

## UNRECOGNIZED SPECIES

The following species apparently belong to *Paradidyma* but have not been identified in the material contained in the United States National Museum. Both species were characterized in abbreviated descriptive terms, which were kindly transcribed for me by the late Dr. J. M. Aldrich. The types are located in the Experiment Station Collection, Lima, Peru.

## ATROPHOPODA PERUANA Townsend

*Atrophopoda peruana* TOWNSEND, Rev. Chil. Hist. Nat., vol. 31, p. 159, 1927.

Body length, 5 mm.; wing length,  $4\frac{1}{4}$  mm. 1 male, Cacaturo, Piura Province, Peru, May 22 on herbage.

Blackish; head silvery white, facial plate and facial ridges gray; parafrontals blackish by direct view, thinly pollinose; frontal stripe dark brown; first antennal joint brown; second joint and palpi very pale fulvous; third joint blackish; pleura silvery, mesoscutellum and scutellum less thickly so; two heavy wide black thoracic vittae unbroken and reaching scutellum; abdomen shining; median vittae and narrow bases of intermediate segments thinly silvery, fourth segment more widely on base. Legs black. Wings pale smoky yellowish on costa and veins. Squamae glassy-whitish.

Apparently quite similar to *Paradidyma* (*Diaphoropeza*) *peruana* (Townsend), which was also described (female only) from Peru. The present form may be the male of the last mentioned species, but it seems impossible to decide without specimens available for comparison.

## PARADIDYMA PERUVIANA Townsend

*Paradidyma peruviana* TOWNSEND, Rev. Chil. Hist. Nat., vol. 31, p. 159, 1927.

Body length, 7 mm.; wing length, 6 mm. One female, Chosica, Peru, 3,000 ft., Oct. 18, indoors.

Differs from *P. validinervis* by female vertical width well over one-third head width; frontals two below base of arista; width of frontal stripe two-thirds of one parafrontal at middle; ocellars of same strength as hind proclinate fronto-orbital; facio-orbitals eight or nine in row along inner edge of para-facials; cheek two-fifths the eye length; third vein bristly halfway to anterior cross vein; apical cell closed considerably before wing tip; hind cross vein much nearer bend of fourth and hardly its own length from same; palpi yellowish or fulvous; four moderately wide, equal black thoracic vittae not very heavy; wing veins yellowish; "nos"<sup>4</sup> infuscate.

According to the description the species is distinct from all other members of the genus by the frontal bristles descending beneath the base of the arista. This character, the wide front, and the strong ocellars should make the species easily recognizable.

<sup>4</sup> Meaning unknown, probably a misprint.





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## REVISION OF THE AMERICAN TWO-WINGED FLIES BELONGING TO THE GENUS CUPHOCERA

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IN THE preparation of this paper I have studied the material in the United States National Museum and the Kansas University Museum, besides my own collection mainly from Texas, and a few specimens from Washington and California. I am under obligations to the late Dr. J. M. Aldrich for the privilege of examining the National Museum material, which includes the types of most previously described forms, and also for his cooperation in supplying references and notes on types not seen by me. To Dr. R. H. Beamer I am indebted for the opportunity of studying the material in the Kansas University Museum collection, which contained several undescribed forms from Western and Southwestern United States. My thanks are due also to J. Wilcox and Charles H. Martin, who generously lent specimens for study from their private collections of west-coast flies.

Sixteen species are characterized in this revision; of this number, 10 are new to science. The types of the new species are deposited in the United States National Museum and the Kansas University Museum.

### Genus CUPHOCERA Macquart

*Cuphocera* MACQUART, Ann. Soc. Ent. France, 1845, p. 267. (Genotype, *Micropalpus ruficornis* Macquart.)—SCHINER, Fauna Austriaca, vol. 1, p. 427, 1862.—VAN DER WULP, Biologia Centrali-Americana, Diptera, vol. 2, p. 35, 1888; *ibid.*, p. 475, 1903.—BRAUER and BERGENSTAMM, Die Zweiflügler des



kaiserlichen Museums zu Wien, no. 4, p. 133, 1889; *ibid.*, no. 6, p. 144, 1893.—COQUILLETT, Revision of the Tachinidae of America, p. 140, 1897.—ALDRICH, Catalogue of North American Diptera, p. 483, 1905.—ADAMS, in Williston's "Manual of families and genera of North American Diptera," ed. 3, p. 377, 1908.

*Palpibraca* RONDANI, Ann. Nat. Napoli, 1845, p. 22 (Genotype, *P. haemorrhoea*, new species=*Micropalpus ruficornis* Macquart); Dipterologiae Italicae Prodomus, vol. 1, p. 63, 1856; *ibid.*, vol. 3, p. 60, 1859.

*Spanipalpus* TOWNSEND, Smithsonian Misc. Coll., vol. 51, p. 110, 1908. (Genotype, *Trichophora miscelli* Coquillett.)

*Deopalpus* TOWNSEND, *Idem.* (Genotype, *D. hirsutus*, new species.)

*Epicuphocera* TOWNSEND, Rev. Mus. Paulista, vol. 15, p. 240, 1926. (Genotype, *E. andina*, new species.)

The type species of all the above genera have been examined in the United States National Museum. The genotype, *Micropalpus ruficornis* Macquart (of Europe), differs from most of our species in possessing rudimentary palpi but slightly larger than in *australis* and *incongrua*, the only American species showing any development of these organs. The occurrence of rudimentary palpi and the absence of ocellar bristles in the genotype are characters of doubtful generic importance. Townsend has proposed the genus *Deopalpus* for *hirsuta*, which has neither palpi nor ocellars, and *Spanipalpus* for *miscelli*, which differs from the genotype, *ruficornis*, in possessing ocellar bristles but no palpi. These characters are subject to some variation within species of this group and are too slight to maintain the last mentioned genera or *Epicuphocera*, which has been proposed on even less important distinctions.

The generic characters of *Cuphocera* as considered herein are as follows: Propleura and eyes bare; head at vibrissae as long as the antennal axis; face somewhat bulging at middle, its ridges flat and bare; parafacial broad, haired and bearing one or more stout bristles on lower part; front broad and two pairs of verticals present in both sexes; frontal bristles in two rows on widest part of parafrontal in the male; ocellars absent in *buccata*, *torosa*, *fucata*, *contigua*, *andina*, and usually in *hirsuta*, present in the other known species; proclinate orbital bristles present in all females and the male of *incongrua*; arista thickened on most of its length, penultimate segment long, not geniculate; vibrissae situated considerably above lower edge of head about on level with mouth; proboscis approximating the height of head; palpi rudimentary or entirely absent; cheek usually three-fourths the eye height. Thoracic chaetotaxy varying somewhat with the species and furnishing several good characters for separating the forms; three sternopleurals invariably present and usually with three postsutural dorsocentrals; scutellum with two to four marginal bristles besides a smaller apical pair. Abdomen generally broader and more robust in female, ovi-

positor short, fleshy and retracted; genitalia of the male with a large platelike lobe on the side, inner forceps united, the outer ones uniformly slender. Legs ordinary in length; hind tibiae with a scattered row of uneven bristles on outer posterior margin; intermediate fore tarsal segments sometimes dilated in the female with the pulvilli short, but moderately enlarged in the male sex. Wings uniform in shape, third vein setulose one-half or more the distance to small cross vein; first posterior cell open far before the wing tip; hind cross vein oblique to fourth, which it joins much nearer the bend than small cross vein; last section of fifth vein usually less than one-half the length of preceding section; costal spine small or vestigial.

*Specific characters.*—The American species of *Cuphocera* separate into two groups on the presence or absence of ocellar bristles. The characters that seem most useful in separating the species are the color of the pleural and parafacial hairs, ground color of the parafrontals, and thoracic chaetotaxy. The structure of the male genitalia is quite distinctive for a number of forms. The width of the front in relation to the total head width appears uniform within narrow limits for most species, and details of the frontal bristles furnish several additional minor points, especially in the male, that are of some service in distinguishing the forms. Minute or rudimentary palpi are present in only two of the known American species. In the female the genitalia appear uniform in structure; the ovipositor is short, fleshy, and retracted.

There are three genera closely related to *Cuphocera*: *Copecrypta* Townsend, aside from its slender build, is distinguished mainly by the characteristic transverse or erect apical cross vein; *Chiloepalpus* Townsend differs most obviously in having the propleura haired; and *Peleteria* Desvoidy has about the same combination of external characters, except that the palpi are well developed.

Very little is known concerning the biology of the species belonging to *Cuphocera*. The few rearings recorded indicate that the species are parasitic mainly on lepidopterous larvae.

#### KEY TO SPECIES OF CUPHOCERA

- |  |                            |
|--|----------------------------|
| 1. Ocellars present.....   | 2.                         |
| Ocellars absent.....   | 9.                         |
| 2. Pleura clothed with pale hairs.....   | 3.                         |
| Pleura wholly black haired.....  | 5.                         |
| 3. Cheek two-thirds to four-fifths the eye height.....   | 4.                         |
| Cheek one-third the eye height, with silvery pollen which is distinctly tinged with yellow; parafacial hairs white; third antennal segment strikingly enlarged, subtriangular, three times as long as second (Brazil)..... | (3) macrocera (Wiedemann). |

4. Parafacial hairs black; third antennal segment widest near apex with anterior margin straight, hardly longer than second segment; parafrontals without any large bristles outside main row (California)----- (1) *miscelli* (Coquillett).  
 Parafacial hairs white; third antennal segment strongly convex on anterior margin and distinctly exceeding length of second; a secondary row of frontal bristles outside main row on widest part of parafrontal (Texas, Arizona)---- (2) *parksii*, new species.
5. Palpi absent----- 6.  
 Minute palpi present; parafrontals black, subshining; face, cheeks and beard golden; apex of fourth abdominal segment orange-yellow (Chile)----- (7) *australis* (Townsend).
6. Scutellum with three or four marginal bristles----- 7.  
 Scutellum with only two marginals; third antennal segment slightly convex or almost straight on front edge; frontal stripe narrower than one parafrontal on upper half; fourth abdominal segment red above on apical third to half (Arizona, California)----- (4) *scutellaris*, new species.
7. Fourth abdominal segment red at least on upper surface----- 8.  
 Fourth abdominal segment black; frontal stripe wider than one parafrontal on entire length; cheek three-fourths eye height; inner forceps of male genitalia moderately long, slender on apical half with a raised median line behind (Arizona).  
 (5) *conformis*, new species.
8. Abdomen black, anal segment wholly red and sharply contrasted with preceding ones; parafrontals pale or yellow in ground color, thinly pollinose; front about one and one-half times width of eye (United States, Mexico)--- (11) *hirsuta* (Townsend).  
 Abdomen broadly red on sides, fourth segment entirely colorous above; ground color of parafrontals obscured by rather dense gray pollen except at vertex; front approximating twice width of eye; apical segment of proboscis unusually slender and about equal to height of head (California)----- (6) *geminata*, new species.
9. Palpi absent----- 10  
 Rudimentary palpi present; four postsutural dorsocentrals (Texas, Arizona)----- (16) *incongrua*, new species.
10. Cheeks clothed with black hairs or bristles----- 11.  
 Cheeks wholly pale haired, about one-third eye height; femora yellow; intermediate fore tarsal segments in female broadly dilated (Cuba)----- (9) *buccata*, new species.
11. Three dorsocentral bristles----- 12.  
 Four dorsocentrals; male with orbital bristles.  
 (16) *incongrua*, new species.
12. Epaulets reddish or yellow----- 13.  
 Epaulets black; scutellum red, bearing four marginals of unequal size, disk with 10 or 12 erect bristles besides a reclinate discal pair; fourth abdominal segment black tinged with red above on basal margin; parafrontals black in ground color before vertex; inner forceps of male genitalia strongly bowed forward (Oregon, California)----- (15) *torosa*, new species.

13. Parafrontals entirely pollinose, yellow in ground color at least on upper part----- 14.  
Parafrontals shining black; scutellum black, with three marginal bristles; third antennal segment but slightly longer than second; cheek three-fourths the eye height (Mexico).  
(13) *fucata* (Van der Wulp).
14. Three sternopleural bristles ----- 15.  
Four sternopleurals; inner forceps of male genitalia laterally compressed at base and unusually narrow (California).  
(14) *beameri*, new species.
15. Third antennal segment largely black; front pulvilli of male normally elongate----- 16.  
Antennae entirely bright yellow; front pulvilli of male small hardly half entire length of apical tarsal segment (Arizona).  
(8) *flavicornis*, new species.
16. Parafrontals thinly pollinose with yellow ground color distinctly apparent ----- 17.  
Parafrontals with dense gray pollen obscuring ground color, which is usually blackish except near vertex; scutellum red, with four marginal bristles; abdomen broadly red on sides in male, intermediate segments black in female with fourth wholly red and contrasting sharply with preceding ones (United States, Canada)----- (10) *contigua*, new species.
17. Scutellum with four marginal bristles of unequal size; parafacial bearing two macrochaetae on lower part; cheek sparsely clothed with fine black hairs----- (11) *hirsuta* (Townsend).  
Scutellum with three marginal bristles; parafacial bearing only one stout bristle; cheek at middle with three or four moderately large bristles and a few scattered short hairs (Peru).  
(12) *andina* (Townsend).

(1) CUPHOCERA MISCELLI (Coquillett)

*Trichophora miscelli* COQUILLETT, Revision of the Tachinidae of America, p. 139, 1897.—ALDRICH, Catalogue of North American Diptera, p. 483, 1905.  
*Spanipalpus miscelli* TOWNSEND, Smithsonian Misc. Coll., vol. 51, p. 110, 1908.

Pleura clothed with pale hairs; ocellar bristles well developed; scutellum with only two lateral bristles; palpi absent.

*Female*.—Front wide, at vertex 0.41 of the head width in the one specimen; parafrontals thinly gray pollinose; median stripe yellow, about as wide as one parafrontal; verticals two pairs, large, inner ones decussate; orbitals two pairs, proclinate; frontals about eight in a single row, which diverges toward the eye on parafacial, descending almost to level with apex of second antennal segment, uppermost two or three bristles reclinate; antennae red, third segment broadened apically, the anterior edge straight, about equal the length of second; arista thickened on proximal two-thirds, penultimate segment about one-fourth as long as the third; face silvery, somewhat bulging at middle, in profile concave below the middle, the front edge of mouth

prominent between the vibrissae; facial ridges flat, bare; parafacials about two-fifths the width of face, with one strong bristle on lower part and black hairs extending upward to lowermost frontals; proboscis rather slender, the apical segment exceeding the height of head; labella small; cheek silvery, clothed with black hairs, about three-fourths the eye height; back of head convex in profile, gray pollinose, clothed with whitish hairs.

Thorax black, gray pollinose; pleura clothed with pale hairs; mesonotum marked with four black stripes; scutellum yellow beyond middle, gray pollinose. Chaetotaxy: Humeral, 5; posthumeral, 2; presutural, 2; notopleural, 2; acrostichal, 3, 3; dorsocentral, 3, 3; intraalar, 3; supraalar, 3; postalar, 2; sternopleural, 2, 1; pteropleural, 2 (broken off scars large). Scutellum with 2 lateral, 1 smaller decussate apical, and a still smaller discal pair; postscutellum normally developed, gray pollinose; calypters opaque, white.

Abdomen rather narrow, black, the sides and apex reddish; covered with changeable gray pollen, which in most views extends to the hind margins of the intermediate segments and to the middle of the fourth; first segment without median marginal bristles; second with one pair, large; third with one pair and three at the side; fourth with an arcuate row of large discals besides a row of smaller marginals.

Legs (only the hind pair present on type specimen) black, the basal segments and tibiae reddish yellow; hind tibiae with a row of irregular bristles on outer posterior side.

Wings grayish hyaline, tinged with yellow along the costa; third vein bristly almost to small cross vein; fourth with a rectangular stumpless bend, beyond which it is concave, thence straight in an oblique angle toward costa; epaulets yellow; costal spine vestigial.

Length, 9 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 3645.

*Remarks*.—Redescribed from one female (type) specimen in the United States National Museum, reared from a chrysalis of *Adisophanes miscellus* in Los Angeles County, Calif., by A. Koebele.

Although the single type specimen was described 37 years ago, no additional material has come to light during this period. The black parafacial hairs readily distinguish the species from both *macrocera* and *parksii*. Other differences are mentioned in the key.

(2) CUPHOCERA PARKSI, new species

*Male*.—Front rather broad, at vertex 0.402 of the head width (average of five, 0.39; 0.4; 0.4; 0.42; 0.4); parafrontals gray pollinose and clothed with intermixed black and white hairs; median stripe pale reddish yellow, narrower than one parafrontal on most of its

length; two pairs of large verticals, inner ones decussate, the outer curving backward and outward; frontals in two irregular rows, the inner or main row extending below the middle of second antennal segment and diverging toward the eye, all except the uppermost one or two pairs directed inward, the latter reclinate; ocellar bristles well developed, proclinate; orbitals absent; face including cheeks pale in ground color, with white subshining pollen; parafacial rather broad, bearing a single stout bristle near the lower corner of eye (in one specimen two, but the lower one small) and sparsely clothed with pale or whitish hairs; face transversely rounded or bulging at middle, in profile concave above mouth which is moderately protuberant, its ridges flat, bearing two or three bristles above the vibrissae; the latter situated about on level with oral margin; cheek about two-thirds the eye height, clothed with fine pale and coarser black hairs; proboscis distinctly exceeding the height of the head, apical segment slender, shining brownish black, labella small; palpi absent; antennae three-fourths the length of face, largely red, third segment unusually broad, strong convex on the anterior margin and about one and one-half times the length of second segment; arista blackish, thickened and tapering toward tip, penultimate segment long, the apical one pubescent and somewhat flattened near base; back of head gray pollinose and densely clothed with white hairs.

Thorax black; mesonotum gray pollinose, marked with four broad black stripes which extend almost to base of scutellum; prosternum bare; pleura gray pollinose, clothed with fine pale hairs; scutellum reddish on apex, covered with changeable gray pollen. Chaetotaxy: Humeral, 4 or 5; posthumeral, 2; notopleural, 2; presutural, 2; acrostichal, 3, 3; dorsocentral, 3, 4; intraalar, 3; supraalar, 3; postalar, 2; pteropleural, 2; sternopleural, 2, 1; scutellum bearing two large lateral, a much smaller suberect decussate apical, and a discal pair; postscutellum normal; calypters opaque, white.

Abdomen rather slender, subshining, black, the sides and apex reddish with rather thin changeable gray pollen, which extends to the hind margins of the intermediate segments; first segment pollinose above, without median marginal bristles; second with a stout pair; third bearing a median pair and three at the side; fourth segment with three irregular rows on apical half; venter gray pollinose, black-haired with pale pile on basal segment; genitalia yellow, with the usual large lobe on the side; the united inner forceps short, clothed with black hairs on base behind, laterally compressed or very thin on about apical third, in profile view uncommonly thick to apex which is broadly rounded; outer forceps blackish, with a large triangular projection near base behind, rather slender beyond and in rear view strongly bowed; penis short, the apex broadly expanded; fifth ster-

nite yellowish, with a moderately broad but not very deep U-shaped incision.

Legs black, lower edge of femora, knees and tibiae reddish; middle tibia with four or five stout uneven bristles on outer front side; hind tibia with about seven smaller bristles on outer posterior edge, the middle one largest; claws and pulvilli shorter than apical tarsal segment.

Wings grayish hyaline; epaulets yellow; third vein setulose almost to small cross vein; fourth vein with a rectangular bend which sometimes bears a short stump, beyond the angle the vein curves inward, thence continues straight in a diagonal direction to costa, narrowly closing first posterior cell far before tip of wing; hind cross vein very oblique to fourth which it joins much nearer bend than small cross vein; last section of fifth vein less than half the length of preceding section; costal spine vestigial.

Length, 10 to 12 mm.

*Type*.—Male, U.S.N.M. no. 50558, from Bexar County, Tex.

*Remarks*.—Described from nine males. In my collection eight specimens from Texas as follows: 1, Marathon, April 13, 1922 (C. S. Rude); 2, Moore, June 7, 1922 (C. S. Rude); 4, Bexar County, February 2, March 5, and April 4, 1923 (H. B. Parks); and 1, Brewster County, reared August 15, 1930, at San Antonio by H. B. Parks, from an unknown lepidopterous larva. In the Kansas University collection, 1 male, from Mescal, Ariz., July 28, 1927 (R. H. Beamer). Named for H. B. Parks, who has donated many specimens of Diptera from the vicinity of San Antonio.

### (3) CUPHOCERA MACROCERA (Wiedemann)

*Tachina macrocera* WIEDEMANN, Aussereuropäische zweiflügelige Insekten, vol. 2, p. 290, 1830.

*Cuphocera macrocera* SCHINER, Reise der österreichischen Fregatte *Novara*, Zool. Theil, Diptera, p. 330, 1868.

*Elachipalpus macrocera* BRAUER and BERGENSTAMM, Die Zweiflügler des kaiserlichen Museums zu Wien, no. 5, p. 406, 1891.

*Cuphocera macrocera* ALDRICH, Proc. U.S. Nat. Mus., vol. 79, art. 19, p. 24, fig. 1, 1929.

*Spanipalpus aldrichi* TOWNSEND, Revista Ent., vol. 1, p. 168, 1931.

The supposed male type, from Brazil, is in the Vienna Natural History Museum. Aldrich has given a complete description of the specimen, with a figure of the head, which is readily accessible. The unusually large, subtriangular third antennal segment readily distinguishes the species from all other members of the genus. Since Wiedemann's specific name applies to antennae of uncommon size, hardly any doubt remains that the specimen represents his true type.

The species, according to Greene's figure, differs from *miscelli* and *parksii* in having the cheek barely one-third the eye height. Other

differences are mentioned in the key and descriptions. The species is not represented in the United States National Museum, and I have not seen the single type specimen.

(4) CUPHOCERA SCUTELLARIS, new species

*Male*.—Front narrower than usual, before vertex 0.322 of the head width (average of five, 0.32; 0.33; 0.31; 0.33; 0.32), widening rapidly below; parafrontals black, covered with dense dull gray pollen to vertex; frontal stripe yellow, narrowed toward triangle and at middle hardly as wide as one parafrontal; ocellars well developed; verticals two pairs, inner ones decussate and the outer divaricate; frontal bristles about nine in a row, the upper one largest, suberect and slightly divergent, the lower one at middle of parafacial near level with middle of second antennal segment; a secondary row of four or five frontals outside the main row on widest part of front; face and cheeks yellow in ground color, covered with lusterless pale grayish-white pollen; parafacial black haired, with three or more moderately large bristles in a row on lower half nearest the eye; face with the lower border protuberant, its ridges flat bearing three or four bristles next to the vibrissae; basal segments of antennae red or yellow, the third black except at base, weakly convex or almost straight in front, distinctly longer than second segment; arista black, short, tapering uniformly to tip, penultimate segment elongate; cheek clothed with rather sparse longish black hairs, about three-fourths the eye height; proboscis rather slender, apical segment shining brown, tapering outward from base, labella small; palpi absent; back of head thickly pale haired.

Thorax gray pollinose and when viewed from the rear with four broad subshining black stripes, the outer ones interrupted at the suture; pleura black haired; scutellum red at apex, dusted with gray pollen. Chaetotaxy: Acrostichal, 2, 3; dorsocentral, 3, 3; intraalar, 2 (none near suture); supraalar, 3; postalar, 2; presutural, 2; notopleural, 2; humeral, 4; posthumeral, 3; pteropleural, 2; sternopleural, 2, 1; scutellum with 2 marginal, a smaller decussate apical, and a still weaker reclinate subdiscal pair; postscutellum black, dusted with gray pollen; calypters opaque, white.

Abdomen reddish on the sides and apex above, subshining, with thin gray pollen, which is changeable in different angles of view; first segment without median marginal bristles; second bearing one pair; third with a marginal row of about 12; fourth with numerous bristles above on apical half or more; intermediate segments without discal bristles; genitalia reddish with the usual large platelike lobe on the sides; inner forceps rather long and united with a slightly raised median line behind, base flat, moder-



ately wide tapering outward to a slender apex; outer forceps with a square shoulder near the base behind, beyond this moderately slender and bowed inward when viewed from the rear, tips blunt, shining black; fifth sternite deeply divided, the lobes bearing numerous long black hairs.

Legs black, tibiae obscurely reddish; middle tibiae with two large bristles on outer front side; hind tibiae with a scattered row of about five uneven bristles on outer posterior edge, one or two bristles situated near the middle in front and three on the inner hind margin; pulvilli tawny, the front pair noticeably longer and slightly exceeding the length of the last tarsal segment.

Wings gray-hyaline; fourth vein with an obtuse angular bend, slightly curved inward beyond, thence straight in a diagonal direction gradually narrowing the first posterior cell which is open far before the wing tip; third vein setulose more than halfway to small cross vein; last section of fifth vein about one-fourth the length of preceding section; epaulets obscurely reddish; costal spine vestigial.

*Female*.—Front at vertex 0.375 of the head width (one specimen); frontal bristles in a single row; two proclinate orbitals present; third antennal segment rather narrow, almost three times as long as broad; median frontal stripe narrower than one parafrontal on entire length; abdomen broadly ovate; first segment with the hind margin rather strikingly oblique at the sides, narrowing the lateral length of the second segment to about two-thirds its median dorsal length; genital opening broadly rounded behind and narrowed in front, ovipositor short, retracted; claws and pulvilli shorter than apical tarsal segment.

Length, 8 to 10 mm.

*Type*.—Male, U.S.N.M. no. 50559.

*Remarks*.—Described from 5 males and 1 female. In the United States National Museum 2 males, including the type, from Cherry Creek Buttes, Ariz., September 21 (C. H. T. Townsend). In Charles H. Martin's collection, 3 males and 1 female, Monrovia Canyon, Calif., October 1929 and September 1931 (C. H. Martin).

(5) *CUPHOCERA CONFORMIS*, new species

Very similar to *hirsuta* but slightly larger; front in male at vertex 0.339 of the head width in the one specimen; parafrontals gray pollinose to vertex; median stripe yellow, wider than one parafrontal on most of its length; verticals two pairs, strong, the inner ones decussate as usual; orbitals absent; ocellars well developed; frontal bristles extending to middle of second antennal segment, bordered by a secondary row on widest part of front; face with dense grayish-white pollen, the lower border rather prominent in

profile, its ridges flat and practically bare; vibrissae about on level with oral margin well above the lower edge of head; parafacial nearly half as wide as face, bearing two large bristles on lower part and with coarse black hairs above extending to the lowermost frontals; antennae red at base; arista moderately thickened and tapering toward tip, penultimate segment long; cheek gray pollinose, clothed with black hairs, about three-fourths the eye height; proboscis slender and somewhat exceeding the height of head; palpi absent; beard dense, pale gray or white. Thoracic chaetotaxy as in *hirsuta*.

Abdomen wholly black, with rather thin changeable gray pollen on last three segments; second segment with a pair of median marginal bristles; third bearing a marginal row; fourth with numerous bristles on apical half; no discals on intermediate segments; genitalia with the usual large lateral lobe; inner forceps moderately long, united, with a narrow slightly raised median line behind, tapering from the base to an acute tip; outer forceps slender beyond a rather prominent shoulder near the base behind; fifth sternite cleft, the lobes clothed with black hairs.

Legs black, the tibiae obscurely yellow; middle tibia with four or five strong bristles on the outer front side; hind tibia bearing a row of uneven bristles on the outer posterior edge; claws and pulvilli moderately elongate.

Wings gray-hyaline; venation normal, third vein setulose about half the distance to small cross vein; costal spine small.

Length, 12 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 50560.

*Remarks*.—Described from one specimen in the United States National Museum from East Verde River, Ariz., 4,500 feet, without collector's label.

(6) CUPHOCERA GEMINATA, new species

*Male*.—Front at vertex 0.44 of the head width (one specimen), widening gradually to antennae; parafrontals yellow with gray pollen extending to vertex; median stripe reddish yellow, narrower than one parafrontal on entire length; ocellar bristles present, rather weak; verticals two pairs, large; frontal bristles seven or eight in the row, the upper two largest, reclinate and divaricate, the lower one about on level with middle of second antennal segment; a secondary row of three frontal bristles outside the lower part of main row; face and cheeks yellow in ground color, grayish-white pollinose; antennae red, third segment largely dark, strongly convex in front and a little longer than the second; arista short, thickened and evenly tapering to tip, the penultimate segment about one-fourth the length of third; parafacial black haired and with two strong bristles close

to eye on lower part; face somewhat bulging at middle with the lower edge protuberant, its ridges flat and bare; cheek sparsely black haired, four-fifths the eye height; apical segment of proboscis more slender than in the other members of the group, about three-fourths the height of head; back of head gray pollinose clothed with gray hairs.

Thorax marked with four narrow dark stripes, which are poorly defined behind the suture; pleura black haired; scutellum red on apical half, dusted with gray pollen. Chaetotaxy: Acrostichal, 2, 3; dorsocentral, 2, 3; intraalar, 3; supraalar, 3; postalar, 2; humeral, 5; posthumeral, 2; notopleural, 2; presutural, 2; pteropleural, 2; sternopleural, 2, 1; scutellum with 4 marginals (one nearest base small) and a decussate apical pair; postscutellum gray pollinose; calypters opaque, white.

Abdomen red, the venter and narrow hind margin of third segment black, a broad obscure dark median stripe on the intermediate segments; the pollen gray, rather thin and changeable when viewed in different angles; first segment without median marginals; second with one pair and three at the side; third with a marginal row of about 10; fourth bristly on the apical half above; intermediate segments without discs; inner forceps short, united, and tapering sharply from base to apical third, the apex narrow and strongly convex behind; outer forceps nearly straight when viewed from behind, evenly tapering, shining black beyond the base; fifth sternite deeply incised, the lobes black, sparsely clothed with black hairs.

Legs black, tibiae largely yellow; pulvilli grayish, shorter than apical tarsal segment; mid tibia with two large bristles on outer front side.

Wings gray-hyaline; fourth vein with a rectangular stumpless bend, shortly beyond which it curves outward continuing in an oblique direction toward costa, narrowing the first posterior cell which is open far before the tip of wing; third vein with a series of bristly hairs extending over halfway to small cross vein; last section of fifth vein about one-fourth the preceding section; epaulets red; costal spine not developed.

Length, 8.5 mm.

*Female*.—Unknown.

*Remarks*.—Described from one male specimen labeled Delfrey, Calif., December 27, 1930 (C. H. Martin); received from Charles H. Martin, to whom it is returned.

The wider front and the presence of marginal bristles on the sides of the second abdominal segment readily distinguish the species from all the other forms possessing ocellar bristles.

## (7) CUPHOCERA AUSTRALIS (Townsend)

*Spanipalpus australis* TOWNSEND, Rev. Chilena Hist. Nat., vol. 31, p. 164, 1927.

Closely resembles *Chiloepalpus* (*Cuphocera*) *aurea* Aldrich, but differs in having the propleura bare and no discal bristles on the intermediate abdominal segments.

*Female*.—Front at extreme vertex 0.327 of the head width in the one specimen, widening rapidly to base of antennae; parafrontals black, subshining, lightly dusted with plumbeous pollen; ocellars well developed; verticals two pairs, inner ones decussate the outer divergent; orbital bristles two, proclinate; frontals about nine arranged in a single row, moderately large, the lower one close to eye about on level with middle of second antennal segment; parafacial yellow, this color sharply limited along the lower frontals and black upward, black haired with a single stout bristle on lower part; front edge of mouth strongly protuberant, face yellow, with thin subshining pale pollen, its ridges flat, bearing two or three bristles next to the vibrissae; basal segments of antennae deep yellow, the third largely black and obliquely truncate at apex, slightly exceeding the length of second segment; arista brownish black, third segment flattened near base, pubescent, penultimate segment long; cheek yellow, thinly pollinose and clothed with long black hairs, about two-thirds the eye height; proboscis moderately stout, distal segment slightly tapering toward tip, shining brownish black; minute or rudimentary palpi present, yellowish, bearing several black hairs; back of head with a ruff of golden hairs which are sparser and somewhat paler on the upper part.

Thorax black, gray pollinose; mesonotum marked with four black stripes; pleura black haired; scutellum black and subshining, lightly dusted with gray pollen. Chaetotaxy: Humeral, 5; posthumeral, 2; notopleural, 2; presutural, 2; acrostichal, 3, 3; dorsocentral, 3, 4; intraalar, 3; supraalar, 3; postalar, 2; pteropleural, 2; sternopleural, 2, 1; scutellum with two marginal and a smaller slightly upturned decussate apical pair, disk sparsely haired, bearing a wide-spaced discal and a more closely approximated subapical pair; postscutellum black, thinly pollinose, pale membranous above; calypters opaque, white, the rims faintly tinged with yellow.

Abdomen shining black, with thin gray pollen, apex of fourth segment bright yellow, this color extending forward on the median line about to basal third; first segment without median marginals; second bearing a rather long stout pair; third with a row of about 12, with wider space between the median and the next bristle toward the side; fourth with a pair of discals situated before the middle and numerous bristles behind these on apical half; intermediate segments.

without discals; genital opening moderately large and elongate, ovipositor short, retracted.

Legs black, tibiae obscurely reddish; middle tibia with four or five large bristles on outer front side; fore tarsal segments somewhat flattened but not noticeably enlarged; claws and pulvilli shorter than last tarsal segment.

Wings gray-hyaline; fourth vein with a rounded rectangular stumpless bend; third vein haired almost to small cross vein; first posterior cell open far before the exact tip of wing; hind cross vein oblique to fourth, joining it at less than one-third the distance from bend to small cross vein; last section of fifth vein obviously less than one-half as long as the preceding section; epaulets reddish; costal spine not developed.

Length, 10 mm.

*Male*.—Unknown.

*Remarks*.—Described from one female specimen in the United States National Museum labeled Puerto Blest., Chile, December 2, 1926 (Shannon).

The type, a female, is in the experiment station at Lima, Peru; I have not seen it.

(8) *CUPHOCERA FLAVICORNIS*, new species

*Male*.—Front at extreme vertex 0.413 of the head width in the one specimen, widening gradually downward; parafrontal rather broad, densely gray pollinose and distinctly wider than the yellow middle stripe; ocellar bristles absent; verticals large, the inner pair decussate and the outer ones divergent; orbitals none; frontals about seven in the main row with the lowermost bristle situated near the eye well below the middle of second antennal segment, the two uppermost bristles strongly divaricate and reclinate, with two supplementary bristles on widest part of front outside the main rows; entire face including cheeks pale in ground color with uniform dense silvery pollen; antennae entirely bright yellow, third segment about twice as long as wide with the apex broadly rounded on front side; second segment about two-thirds the length of third; arista brown, moderately thickened and tapering to tip, penultimate segment elongate; parafacial with about six small black hairs extending along the margin of eye and two larger bristles on the lower part; face slightly bulging at middle, the lower border moderately protuberant, its ridges flat with one or two bristles above the vibrissae; proboscis somewhat exceeding the height of head, apical segment rather thick at base tapering to tip, labella small; palpi absent; cheek with sparse black hairs, about four-fifths the eye height; back of head gray pollinose faintly tinged with yellow above, clothed with dense pale hairs.

Thorax black, gray pollinose, marked with four distinct black dorsal stripes; pleural hairs black; scutellum red, dusted with uniform gray pollen. Chaetotaxy: Acrostichal, 2, 3; dorsocentral, 3, 3; humeral, 6; posthumeral, 2; notopleural, 2; presutural, 2; intraalar, 3; supraalar, 3; postalar, 2; pteropleural, 2; sternopleural, 2, 1; scutellum with 4 marginal bristles (the basal one small), besides a suberect decussate apical and a reclinate discal pair of nearly equal size, numerous erect bristly hairs on disk; postscutellum normally developed, gray pollinose; calypters opaque, white.

Abdomen reddish on sides of intermediate segments, the fourth entirely so; with rather uniform gray pollen extending to the hind margins of segments two to four; first segment pollinose on the sides above, without median marginal bristles; second with a stout pair; third bearing a marginal row of about 10; fourth with numerous bristles on apical half; no discals on intermediate segments; genitalia yellow; inner forceps moderately broad at base with a slight median groove behind, united and tapering to tip; outer forceps as usual, brownish black; fifth sternite with a broad V-shaped incision, the lobes blackish bearing a few hairs along the inner margin.

Legs black; middle tibia with a row of five or six large bristles on outer front side; hind tibia with a scattered row of uneven smaller bristles on outer posterior edge and others on the inner side; claws and pulvilli distinctly shorter than the apical tarsal segment.

Wings grayish hyaline; fourth vein with a rectangular bend which bears a short stump, concave immediately beyond the angle thence slightly undulating in an oblique direction to costa; first posterior cell open far before the wing tip; third vein setulose nearly to small cross vein; last section of fifth vein two-fifths the length of preceding section; epaulets reddish; costal spine small.

Length, 9.5 mm.

*Female*.—Unknown.

*Holotype*.—Male, in the Kansas University Museum.

*Remarks*.—Described from one male specimen taken in Pima County, Ariz., July 27, 1927, by R. H. Beamer.

The species resembles *parksii*, from which it differs most obviously in having no ocellars; the hairs on pleura, cheeks, and parafrontals are entirely black; the parafacials with two stout bristles on lower part and a few scattered inconspicuous black hairs. The genitalia show additional differences.

(9) CUPHOCERA BUCCATA, new species

Differs from all other species in having the cheeks wholly pale haired. The intermediate fore tarsal segments are broadly dilated in the female sex.

*Female*.—Front at extreme vertex 0.311 of the head width in the one specimen; median stripe reddish yellow, narrowed uniformly toward triangle, at base of antennae about as wide as one parafacial; sides of front thinly gray pollinose to vertex, blackish in ground color; ocellar bristles absent; inner verticals moderately large and reclinate, outer ones a little smaller, divergent; frontal bristles about seven in a single row, descending hardly to the middle of second antennal segment, three anterior ones directed inward, the others reclinate, upper pair small, slightly behind these outside of the row a second pair larger and divaricate; orbitals three pairs, proclinate; face silvery pollinose, its lower border protuberant, the ridges very flat, bare; parafacial with two stout bristles and a few black hairs on lower part with only pale hairs above; antennae red, third segment strongly convex in front, slightly shorter than second segment; arista dark brown, thickened on proximal two-thirds, penultimate segment elongate; cheek yellow in ground color, silvery pollinose about one-third the eye height; palpi absent; proboscis moderately long, apical segment tapering from base to tip; labella small; beard grayish white.

Thorax black, dusted with gray pollen; mesonotum marked with four black stripes; pleura clothed with black hairs; scutellum red on apex, gray pollinose. Chaetotaxy: Acrostichal, 3, 3; dorsocentral, 3, 3; humeral, 6; posthumeral, 2; presutural, 2; notopleural, 2; intralar, 3; supraalar, 3; postalar, 2; pteropleural, 2; sternopleural, 2, 1; scutellum with 3 lateral (median one small), 1 decussate suberect apical, besides two pairs of weak reclinate bristles on disk behind the middle; postscutellum gray pollinose, membranous above; calypters white.

Abdomen black, subshining, with thin gray pollen, which is changeable in different views, anal segment except on sides near base red; first segment without median marginal bristles; second with one rather short stout pair; third with one pair and three at the side; fourth bearing a row of about eight discals besides a row of weaker submarginals with still smaller bristles along the margin; intermediate segments without discals.

Legs yellow (hind pair missing), tarsi black; mid tibia with two stout bristles on outer front side near middle; three intermediate fore tarsal segments broad and flattened, the apical segment less than one-half as large as preceding one; claws and pulvilli short.

Wings gray-hyaline; fourth vein with an almost rectangular bend, beyond slightly concave, thence straight to costa narrowing the first posterior cell which is open far before the wing tip; hind cross vein oblique to fourth which it joins a little nearer bend than small cross vein; last section of fifth vein more than half the length of preceding

section; third vein with bristly hairs extending about halfway to small cross vein; epaulets red; costal spine not developed.

Length, 7.5 mm.

*Male*.—Unknown.

*Type*.—Female, U.S.N.M. no. 50561.

*Remarks*.—Described from one female specimen in the United States National Museum labeled Havana, Cuba (Baker), collection J. M. Aldrich.

(10) CUPHOCERA CONTIGUA, new species

*Male*.—Front at vertex 0.386 of the head width (average of five, 0.38; 0.39; 0.4; 0.38; 0.38), widening rapidly below; parafrontals yellow on upper part becoming blackish downward, with rather dense gray pollen which extends to the vertex; median stripe yellow, narrower than one parafrontal on entire length; verticals two pairs, large; ocellars absent; frontal bristles descending about to apex of second antennal segment, lowermost bristle close to eye, the upper two slightly longer, divergent and reclinate; a secondary row of four or five frontal bristles outside the main row on widest part of front; face and cheeks yellow, covered with thick grayish-white pollen; antennae red, third segment infuscated, rather evenly convex from base to tip on front edge and only slightly longer than second segment; arista black, moderately thick, tapering to tip, penultimate segment elongate; parafacial black-haired with two large bristles near eye on lower part; face protuberant on the lower border, its ridges flat and practically bare; apical segment of proboscis tapering outward, shining brownish black, labella small; palpi absent; cheek clothed with black hairs, about four-fifths the eye height; back of head gray pollinose, thickly clothed with pale hairs.

Thorax gray pollinose, with four dark dorsal stripes which are poorly defined behind suture; pleural hairs black; scutellum red beyond base, dusted with gray pollen. Chaetotaxy: Acrostichal, 3, 3; dorsocentral, 3, 3; intraalar, 3; supraalar, 3; postalar, 2; humeral, 6; posthumeral, 3 (anterior one small); notopleural, 2; presutural, 2; pteropleural, 2; sternopleural, 2, 1; scutellum with 4 marginal (one nearest base small), a decussate apical pair, and several weak bristles scattered on disk; postscutellum black, gray pollinose; calypters opaque, white.

Abdomen subshining, reddish with a broad dark median stripe on the intermediate segments which expands on the narrow hind margin of the third and includes most of the first, the extreme apex of the fourth also sometimes blackish; dusted with thin gray pollen, which is changeable in different angles of view; first segment without median marginals; second with a pair and one at the side; third bearing a marginal row of 10 or 12; fourth with a discal row



and numerous bristles before apex on upper surface; inner forceps bowed forward near base, short and united, triangular, posterior surface near base convex, minutely punctate; outer forceps tapering rather evenly to an acute apex, shining brownish-black; fifth sternite with a narrow deep incision, the lobes clothed with fine black hairs.

Legs black, tibiae obscurely reddish; middle tibia with three or four bristles of unequal size on outer front side. Claws and pulvilli elongate, the front ones obviously longer than apical tarsal segment.

Wings gray-hyaline, small cross vein slightly infuscated; fourth vein with a rectangular stumpless bend, curved inward for a short distance beyond the angle thence straight in a diagonal direction to the costa; first posterior cell narrowly open far before the wing tip; last section of fifth vein about one-fourth the length of preceding section; third vein setulose to the small cross vein; costal spine not developed; epaulets reddish.

*Female*.—Hardly distinguishable from *hirsuta*, but the sides of the front are usually darker and more densely pollinose. Front at the vertex, 0.4 of the head width (average of five, 0.4, 0.41, 0.4, 0.41, 0.38); the usual two proclinate orbitals present with one or two reclinate bristles between these and the main frontal row; abdomen usually darker on the sides than in male, anal segment entirely red; pulvilli short, otherwise similar to male.

Length, 8 to 13 mm.

*Holotype*.—Male, from Giant Forest, Calif., in Kansas University Museum.

*Remarks*.—Described from 22 males and 13 females. In the Kansas University collection 8 males and 1 female, Giant Forest, Calif., July 28, 1929 (R. H. Beamer and Paul W. Oman); 1 male, Big Bear Lake, Calif., July 26, 1932 (R. H. Beamer); 1 male and 1 female, Jacinto Mountains, Calif., July 21, 1929 (R. H. Beamer); 1 male and 2 females, Huachuca Mountains, Ariz., July 8, 1932 (R. H. Beamer); 2 males and 5 females, Oak Creek Canyon, Ariz., 6,000 feet, July and August (F. H. Snow); 2 males and 2 females, Magdalena Mountains, N. Mex., August 1894 (Snow); 3 males, without locality, labeled "Col. Snow" and one "Bailey Col., Aug. '90"; 1 female, Oliver, British Columbia, August 6, 1931 (L. D. Anderson). In National Museum 1 male, Bead Lake, Newport, Wash. (M. C. Lane). In J. Wilcox's collection 2 males, Antelope Mountain, Grant County, Oreg., August 13, 1932 (D. K. Frewing), and 1 female, Mount Rainier, Wash., White River Camp (J. Wilcox). In Charles H. Martin's collection 1 male, Monrovia Canyon, Calif., September 18, 1931 (C. H. Martin).

The specimens studied vary considerably in size, but I have been unable to find any tangible characters to separate additional forms. The species has been recorded from New York by West under the

unpublished manuscript name *C. stricklandi* Curran (New York State List, p. 819). The allotype female and three paratypes (both sexes) of Curran's proposed *Trichophora stricklandi* are now in the Kansas University collection and were kindly loaned to me for study by Dr. R. H. Beamer.

(11) CUPHOCERA HIRSUTA (Townsend)

*Deopalpus hirsutus* TOWNSEND, Smithsonian Misc. Coll., vol. 51, pp. 110-111, 1908.

*Cuphocera aurifrons* REINHARD, Ent. News, vol. 35, p. 54, 1924.

Originally described from a single male specimen from Meadow Valley, 7,300 feet, Chihuahua, Mexico. The type is in the United States National Museum. Full descriptions of the species are readily accessible, to which may be added the following additional items: Front in male 0.362, in female 0.384, of the head width (average of five specimens measured for each sex). Male genitalia reddish, with the usual broad lateral lobe; inner forceps united, ordinary in length with the sides tapering rather sharply to the apical third, apex narrow and rounded, hind surface on basal half usually flat or slightly convex sometimes with a narrow shallow median groove; outer forceps rather stout, tapering shortly before apex, inner surface concave on apical third, in profile bowed backward with a rather square shoulder near base behind; fifth sternite deeply divided, the lobes reddish bearing a few black hairs along the margin of the incision.

The conspicuous pale or yellow ground color of the front readily distinguishes the species from *fucata*, with which it apparently has been confused. In Texas *hirsuta* is the commonest member of the genus. It has been collected at College Station from April to November. Additional locality records include Colorado, Kansas, Ohio, and Illinois.

(12) CUPHOCERA ANDINA (Townsend)

*Epicuphocera andina* TOWNSEND, Rev. Mus. Paulista, vol. 15, p. 240, 1926.

*Male*.—Front broad, at vertex 0.423 of the head width (one specimen), yellow in ground color, the sides subshining, thinly pollinose, and clothed with black hairs; frontal stripe pale yellow, not very sharply defined; ocellar bristles absent; inner verticals large and decussate, the outer ones of nearly equal size, divaricate; frontal bristles about eight in the row, the upper one largest, suberect, the lower one at middle of parafacial near level with apex of second antennal segment; a second row of about four large frontal bristles outside the lower part of the main row; parafacial black haired with one stout bristle on lower part, yellow in ground color covered with whitish pollen; antennae red, third segment mostly black, weakly convex in front with the apex broadly rounded, about equal the

length of second segment; arista brown, thickened as usual and tapering toward tip, penultimate segment long; face yellow, silvery pollinose, the lower border prominent and its ridges flat and bare; cheeks silvery pollinose on yellow ground color, bearing three or four moderately large bristles at middle, about three-fourths the eye height; proboscis rather long and slender, apical segment tapering toward tip, with a small labella; palpi absent; beard white.

Thorax black, gray pollinose, with four narrow black dorsal stripes, the outer ones interrupted at suture; pleura clothed with black hairs; scutellum dusted with gray pollen, apex red. Chaetotaxy: Acrostichal, 3, 3; dorsocentral, 3, 3; humeral, 5; posthumeral, 2; notopleural, 2; presutural, 2; intraalar, 3; supraalar, 3; postalar, 3; petropleural, 2 (large); sternopleural, 2, 1; scutellum with 3 lateral, 1 small decussate suberect apical, and a discal pair situated behind the middle; postscutellum normal, gray pollinose; calypters opaque, white.

Abdomen black, subshining, with thin changeable gray pollen on three basal segments, sides of the intermediate ones tinged with red; anal segment wholly red, covered with dense whitish pollen to tip; first segment without median marginal bristles; second with one stout pair; third with a still larger pair and four at the side; fourth with a strongly arcuate row of about 10 discals, behind these a submarginal and a marginal row of smaller bristles; no discals on intermediate segments; genitalia reddish with a large paler lateral lobe; inner forceps united on entire length and bowed forward, convex at base behind, the surface punctate clothed with fine hairs, tapering beyond middle to a narrow blunt apex; outer forceps bowed backward near base and directed inward when viewed from the rear, shining black on apical half; fifth sternite with a broad U-shaped incision, the lobes reddish, lightly sprinkled with pollen and sparsely black haired.

Legs black, tibiae reddish; front claws and pulvilli shorter than apical tarsal segment; mid tibia with two stout bristles on outer front side near base; hind tibia with a row of about five wide-spaced uneven bristles on outer posterior side.

Wings gray-hyaline; third vein with bristly hairs extending almost to small cross vein; last section of fifth vein distinctly less than half the length of preceding section; fourth vein with a rounded rectangular stumpless bend; the apical cross vein undulates slightly and gradually narrows the first posterior cell which is open far before the tip of wing; costal spine vestigial; epaulets red.

*Female*.—Front at vertex 0.434 of the head width in the one specimen; orbital bristles two or three proclinate and one divergent reclinate pair situated slightly before the uppermost frontal outside

the row; third antennal segment about one and one-half times as long as wide; otherwise very similar to male.

Length, 9 mm.

*Remarks.*—Redescribed from one male and one female in the United States National Museum, from Verrugas Canyon, Peru, 5,500 feet, July 2, 1913 (C. H. T. Townsend). The type locality is Mantucana, Peru; type, female, in the Experiment Station collection, Lima, Peru.

The species resembles *hirsuta* but is readily distinguished by the strong bristles on the middle of the cheek, wider front, and three marginal scutellar bristles. There are other minor differences.

(13) CUPHOCERA FUCATA (Van der Wulp)

*Trichophora fucata* VAN DER WULP, Tijdschr. Ent., vol. 35, p. 193, 1892; *Biologia Centrali-Americana*, Diptera, vol. 2, p. 476, 1903.

*Cuphocera fucata* COQUILLETT, Revision of the Tachinidae of America, p. 140, 1897.—ALDRICH, Catalogue of North American Diptera, p. 483, 1905.

*Male.*—Front at vertex 0.3 of the head width (one specimen), widening rapidly to base of antennae; parafrontals largely shining black, gray pollinose below and at outer corners of vertex; median stripe yellow narrowed toward triangle, where it is less than half the parafrontal width; ocellar bristles absent; verticals two large pairs; orbitals absent; frontal bristles on widest part of parafrontal arranged in two rows, which diverge strongly beneath base of antennae, descending below middle of second segment, uppermost three bristles in the main row reclinate, the remainder directly inward; face noticeably bulged at middle, silvery pollinose, in profile concave above the mouth which is strongly protuberant; facial ridges flat and bare; parafacial with two stout bristles on lower part and black hairs extending upward to lowermost frontals; cheek silvery pollinose, sparsely clothed with black hairs, about three-fourths the eye height; antennae reddish yellow, third segment infuscated, strongly convex on anterior edge and slightly exceeding length of second segment; arista blackish, penultimate segment about one-fifth the length of third which is pubescent; palpi absent; proboscis moderately slender, apical segment tapering from base to tip, labella small; back of head convex in profile, thickly clothed with pale or grayish-white hairs.

Thorax black, gray pollinose, marked with four dorsal subshining black stripes; scutellum black, dusted with changeable gray pollen. Chaetotaxy: Humeral, 6; posthumeral, 2; notopleural, 2; presutural, 2; dorsocentral, 3, 4; acrostichal, 3, 3; intraalar, 3; supraalar, 3; postalar, 3; pteropleural, 2; sternopleural, 3; scutellum with 3 laterals besides one smaller decussate apical and a discal pair; post-

scutellum normally developed, gray pollinose; calypters semitransparent, white.

Abdomen black, the sides and apex tinged with red, with changeable gray pollen on all segments, apical third to half of last two shining in most views; first segment without median marginals; second bearing a rather short stout pair; third with a marginal row of 8; fourth with several rows of discals besides the usual marginal row, intermediate segments without discals; genitalia ordinary in size; inner forceps short, united, thickened at base, tapering sharply to an acute tip, yellow; fifth sternite blackish, deeply divided, the lobes clothed with short, fine hairs.

Legs black, tibiae at middle and the knees yellowish; mid tibia with two large and two smaller bristles on outer front side; hind tibia with four or five bristles of varying size on the outer hind edge; claws and pulvilli normally elongate.

Wings faintly tinged with yellow along the costal margin; veins bare except third which is setulose almost to small cross vein; fourth vein with a rectangular bend which bears a short appendage, beyond the bend concave to costa, which it reaches about one-half the length of the hind cross vein before the wing tip; costal spine not developed; epaulets red.

Length, 8 mm.

*Remarks.*—Redescribed from one male (cotype) specimen in the United States National Museum from Atoyac, Vera Cruz, April (H. H. Smith).

There are a number of references to the species, as "*C. furcata*", from the United States; these are all subject to verification. The shining black parafrontals readily separate it from *hirsuta*, with which it seemingly has been confused. I have not seen any specimens of the female.

(14) CUPHOCERA BEAMERI, new species

Distinguished from all other known species of this group in having four sternopleural bristles. In other details the species is very similar to *contigua*, from which it differs most essentially in having the inner genital forceps laterally compressed at the base, rather slender and uniformly tapering to a narrow apex, behind straight in profile view with a slight median keel extending from base to tip; outer forceps as usual. Front (before vertex) 0.381 of the head width (one specimen), widening rapidly downward; cheek about four-fifths the eye height, bearing rather coarse black hairs; back of head thickly clothed with pale-yellowish hairs; front pulvilli greatly enlarged, about one and one-half times the length of apical tarsal segment.

Length, 12 mm.

*Female.*—Unknown.

*Holotype*.—Male, in the Kansas University Museum.

*Remarks*.—One specimen collected in San Diego County, Calif., July 4, 1929, by R. H. Beamer.

(15) CUPHOCERA TOROSA, new species

*Male*.—Front at vertex 0.387 and 0.373 of the head width in the two specimens; parafrontals blackish, gray pollinose to vertex; median stripe yellow, triangular, at middle narrower than one parafrontal; ocellar bristles absent or hairlike; verticals two pairs, large; frontal bristles in a double row below the middle, the lowermost bristles near the eye almost on level with apex of second antennal segment, two or three uppermost bristles suberect or reclinate the remainder directed inward and upward; antennae red, third segment mostly black, strongly convex in front, slightly longer than the second segment; arista black, tapering evenly to tip, penultimate segment long; face silvery pollinose, its lower border strongly protuberant, the ridges flat bearing one or two bristles above the vibrissae; parafacials broad, with two macrochaetae on lower part and clothed with numerous slender black hairs except along the inner margin; cheek with rather dense cinereous pollen, black haired, about three-fourths the eye height; proboscis equal the height of head, the distal segment shining brown, tapering apically from base, labella small; palpi absent; beard grayish white.

Thorax black, gray pollinose, with four indistinct black dorsal vittae; pleura black haired; scutellum except at base red, thinly sprinkled with gray pollen. Chaetotaxy: Acrostichal, 3, 3; dorso-central, 3, 3; postalar, 3 or 4; intraalar, 3; supraalar, 3; presutural, 2; humeral, 6; posthumeral, 3 (anterior one small); notopleural, 2; pteropleural, 2 (large); sternopleural, 2, 1; scutellum bearing 4 marginals of unequal size, a strong suberect apical pair, decussate at tip, disk with 10 or 12 erect moderately large bristles besides a stouter reclinate pair shortly before the apex; postscutellum black, gray pollinose; calypters opaque, white.

Abdomen black, the sides and fourth segment above obscurely reddish, with gray pollen which extends thinly over the upper surface somewhat denser on bases of last three segments; first segment without median marginal bristles; second with a large pair; third bearing a marginal row of about 10, large; fourth with a discal row and numerous erect bristles on apical half; intermediate segments without discals; genitalia ordinary in size, with a large reddish lateral lobe; the united inner forceps blackish, convex near base behind the surface punctate and clothed with black hairs, in profile view strongly bowed forward beyond middle, the apex tapering to a narrow rounded tip, smooth and shiny; outer forceps red at base shining black beyond, tapering to an acute tip, strongly bowed with

the convex side in front; fifth sternite black, deeply divided, the lobes with a few black hairs.

Legs black, tibiae obscurely reddish at middle; claws and pulvilli elongated; middle tibia with two or three large bristles on outer front side; hind tibia with a row of about six uneven bristles on outer posterior edge.

Wings grayish hyaline; third vein setulose two-thirds the distance to small cross vein; fourth vein with an almost rectangular bend curving inward beyond thence straight in a diagonal direction to costa; first posterior cell open far before the wing tip; epaulets black; costal spine not developed.

Length, 12 to 13.5 mm.

*Female*.—Unknown.

*Type*.—Male, U.S.N.M. no. 50562, from Gold Beach, Oreg.

*Remarks*.—Described from one male in the United States National Museum collected at Gold Beach, Oreg., July 12, 1924, by H. A. Scullen, and one male in the Kansas University Museum collection taken by R. H. Beamer, San Jacinto Mountains, Calif., July 21, 1929.

(16) *CUPHOCERA INCONGRUA*, new species

Readily recognized in the male sex by the presence of two strong proclinate orbital bristles; ocellars and usually the palpi absent; propleura bare; intermediate abdominal segments without discals.

*Male*.—Front broad, at vertex 0.383 of the head width (average of three, 0.38; 0.37; 0.4), yellow in ground color, the sides thinly gray pollinose and clothed with black fine hairs; frontal stripe pale yellow, narrower than one parafrontal on entire length; verticals two pairs, large; frontals about eight in the row which is suddenly divergent beneath the antennae extending about to level with middle of the second segment; two or three extra frontal bristles situated between the orbitals and the main row; face and cheeks yellow in ground color covered with silvery subshining pollen; antennae red, third segment mostly dark, about as broad as long and distinctly shorter than second segment; arista dark brown, evenly tapering, penultimate segment about twice the length of first; parafacial broad, with two stout bristles near eye on lower part and clothed with scattered black hairs except on inner margin; facial ridges flat, bearing one or two bristles above vibrissae; face moderately bulged at middle, its lower border strongly protuberant; cheeks rather sparsely clothed with coarse black hairs, about three-fourths the eye height; proboscis about equal the height of head, distal segment narrowed toward tip, shining reddish brown, labella compressed not thicker than proboscis; minute palpi present in one

and absent in the other two specimens; back of head thickly clothed with long pale grayish hairs.

Thorax black, gray pollinose, with four dark dorsal vittae which are distinct before the suture and somewhat less defined behind; hairs on pleura black; scutellum wholly red, thinly dusted with gray pollen. Chaetotaxy: Acrostichal, 3, 3; dorsocentral, 3, 4; intraalar, 3; supraalar, 3; postalar, 2; humeral, 5 or 6; posthumeral, 3 (anterior one sometimes small); notopleural, 2; presutural, 2; pteropleural, 2 (large); sternopleural, 2, 1; scutellum with three marginal, a smaller suberect decussate apical and a reclinate discal pair situated well behind the middle; disk bearing about 10 erect bristles besides numerous smaller hairs; postscutellum black, pale membranous on upper part; calypters white.

Abdomen red with a broad black dorsal stripe widening on the second segment and including most of the first; gray changeable pollen on most of the upper surface; first segment without median marginal bristles; second with one pair; third bearing a marginal row of about ten; fourth with numerous bristles above on apical half; genitalia reddish black with a large lobe on each side; inner forceps united and wider than usual, broadly sulcate on the apical third behind, apex broadly rounded or blunt; inner forceps short, very slender, terminating in an acute minute hook; penis bowed forward at middle, the apex prolonged behind and bordered with a pale membrane; fifth sternite with a broad V-shaped incision, the lobes reddish, bearing black hairs along the darker inner margins and finer brown hairs near the middle.

Legs black, tibiae reddish; pulvilli tawny, the front ones distinctly longer and about equal the last tarsal segment; mid tibia with two or three stout bristles on outer front side; hind tibia with about six wide-spaced uneven bristles on the outer posterior edge, and two moderately large ones near middle on the inner side.

Wings grayish hyaline, small cross vein slightly infuscated; fourth vein with a stumpless rectangular bend, shortly beyond which it curves outward, thence almost straight in an oblique direction to costa; first posterior cell narrowly open far before wing tip; third vein with only four or five hairs near base; last section of fifth vein about two-fifths the length of preceding section; epaulets reddish; costal spine small.

Length, 10 to 11 mm.

*Female*.—Unknown.

*Paratype*.—Male, U.S.N.M. no. 50563.

*Remarks*.—Described from two males in my collection taken at Balmorhea, Tex., August 4, 1922, by C. S. Rude, and one male (holotype) in the Kansas University collection from Mescal, Ariz., July 28, 1927 (R. H. Beamer).



In the structure of the genitalia the species is distinct from all other members of the genus and shows a rather close relationship to *Peleteria*. It is included here mainly on the absence of any palpi.

SPECIES PREVIOUSLY PLACED IN CUPHOCERA, BUT NOT HEREIN IDENTIFIED  
OR REFERRED TO OTHER GENERA

*aurea* ALDRICH, Proc. U.S. Nat. Mus., vol. 69, art. 22, p. 25, 1926 (*Cuphocera*).

Belongs to the genus *Chiloepalpus*.

*californiensis* MACQUART, Diptères exotiques nouveaux ou peu connus, suppl. 4, pt. 2, p. 148, 1851 (*Micropalpus*).—COQUILLETT, Revision of the Tachinidae of America, p. 140, 1897 (*Cuphocera*). I have not identified this species. The type is in J. E. Collin's collection, Newmarket, England.

*erythrostoma* BIGOT, Annales, no. 41, p. 95, 1888 (*Epalpus*).—BRAUER, Sitz. Akad. Wiss. Wien, Math.-nat. Classe, vol. 107, p. 504, 1898 (*Cuphocera*). This species has not been determined in the material examined.

*nitidifrons* VAN DER WULP, Biologia Centrali-Americana, vol. 2, p. 37 (1888) and p. 477 (1903) (*Trichophora*).—SCHINER, Reise der österreichischen Fregatte *Novara*, Zool. Theil, Diptera, p. 330, 1868, as *Cuphocera macrocera* (Wiedemann), which (in part) equals *Copecrypta nitidifrons* (Van der Wulp) (Aldrich, Proc. U.S. Nat. Mus., vol. 74, art. 19, p. 24, 1929).

*ruficauda* VAN DER WULP, Tijdschr. Ent., vol. 10, p. 146, 1867 (*Schineria*).—COQUILLETT, Revision of the Tachinidae of America, p. 139, 1897 (*Trichophora*).—WILLISTON, Trans. Amer. Ent. Soc., vol. 13, p. 305, 1886 (*Cuphocera*), equals *Copecrypta nitens* (Wiedemann) (Aldrich, Proc. U.S. Nat. Mus., vol. 74, art. 19, p. 27, 1929).



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## SOME FOSSIL CORALS FROM THE WEST INDIES

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IN THE United States National Museum are three small collections of fossil corals from the West Indies, containing a number of new or otherwise interesting forms: Two collections from the Upper Cretaceous and Eocene of Jamaica, made by Dr. C. T. Trechmann and Dr. C. A. Matley; and one from the Scotland beds of Barbados, made by Dr. Trechmann. These collections were sent at different times to Dr. T. Wayland Vaughan for determination, but as he was unable to work on them he turned them over for report to the author during his tenure of a Storror fellowship of the National Research Council. A preliminary study was carried on under the direction of Dr. Vaughan at the Scripps Institution of Oceanography, and the final work done at the United States National Museum.

Material from a fourth lot, the Romanes collection from Barbados, was lent to the author through the courtesy of Dr. H. Dighton Thomas, of the British Museum (Natural History), and notes on this are included in the discussion of the Matley collection from Barbados.

Because the collection contains corals of different ages and from different areas, the report is divided into four parts as follows:

(1) The Trechmann and Matley collections from the Upper Cretaceous of Jamaica (p. 74); (2) the Trechmann collection from the lower Eocene Richmond beds of Jamaica (p. 93); (3) the Trechmann and Matley collections from the middle Eocene Yellow limestone of Jamaica (p. 94); (4) the Trechmann and Romanes collec-

tions from the Scotland beds of Barbados (p. 103). Notes on the occurrence of the corals are given preceding the first part and at the beginning of the last part.

The author is deeply indebted to Dr. Vaughan for his careful guidance in the study of these collections and for his extending to him the facilities of the Scripps Institution while working there. To the authorities of the United States National Museum he is indeed grateful for the full use of the splendid collections and the library facilities, and for making the photographs used in the plates.

*Occurrence of the Upper Cretaceous and Eocene corals of Jamaica.*—The specimens from the Upper Cretaceous come from beds to which Trechmann has assigned a Campanian (Maastrichtian?) age (the Catadupa beds of R. T. Hill). One series of specimens, all of *Trochocyathus matleyi*, new species, comes from near the top of Blue Mountain Peak from beds that have been shown by Matley (1929, p. 458) to be Upper Cretaceous. The two specimens from the lower Eocene in the Trechmann collection are from the Richmond formation, but these may be derived Cretaceous in origin, according to a note by Dr. Trechmann on the labels. The specimens in the Trechmann and Matley collections from the middle Eocene are from the Yellow limestone (the Cambridge formation of R. T. Hill). The stratigraphic relations of the Upper Cretaceous formations, the Richmond formation, and the Yellow limestone have been discussed by Trechmann in a series of recent papers (1922a, 1922b, 1923, 1924a, 1924b, 1929).

The Upper Cretaceous formations of Jamaica are now known to contain the following species and varieties of corals, including those described as new herein:

*Paracyathus* (?) sp. Trechmann, 1929.<sup>1</sup>

*Trochocyathus matleyi*, new species.

*Dichocoenia trechmanni*, new species.

*Rhabdophyllia quaylei*, new species.

*Cladocora jamaicensis* Vaughan, 1899.<sup>1</sup>

*Dictuophyllia conferticostata* (Vaughan, 1899).

*Dictuophyllia conferticostata columnaris* (Vaughan).<sup>2</sup>

*Stiboriopsis jamaicensis* Vaughan, 1899.<sup>1</sup>

*Trochoseris catadupensis* Vaughan, 1899.

*Centrastrea hilli*, new species.

*Vaughanoseris catadupensis*, new genus and species.

*Cyathoseris haidingeri* Duncan, 1865 (*non* Reuss).<sup>1,2</sup>

*Mesomorpha catadupensis* Vaughan, 1899.<sup>1</sup>

*Favoseris anomalos*, new genus and species.

<sup>1</sup> Not found in either the Trechmann or Matley collections and so not discussed in this paper.

<sup>2</sup> A fragment from Duncan's specimen is in the National Museum. It does not show the structure of *Cyathoseris* but appears to be one of the colonial Leptophylliids in the neighborhood of *Sematethmos* Gregory.

- Leptophyllia agassizi* Vaughan, 1899.<sup>1</sup>  
*Diplaræa* (?) *boltonae*, new species.  
*Cyclolites jamaicaensis*, new species.  
*Paracycloseris elizabethae*, new genus and species.  
*Synastrea* (?) *adkinsi*, new species.  
*Prodiploastrea schindeuolffi*, new genus and species.  
*Multicolumnastrea cyathiformis* (Duncan, 1865).  
*Goniopora reussiana* (Duncan, 1865).  
*Goniopora trechmanni*, new species.

The following is a complete list, so far as is known to the author, of the species of corals from the Eocene of Jamaica:

LOWER EOCENE (Richmond beds):

- Stylophora contorta* (Leymerie) *vide* Duncan, 1865.<sup>1</sup>  
*Stylophora* species a.  
*Stylophora* species b.  
*Astrocoenia duerdeni* (Vaughan, 1899).<sup>1</sup>  
 ?*Columnastrea eyrei* Duncan, 1867.<sup>1</sup>

MIDDLE EOCENE (Yellow limestone):

- Stylophora cambridgensis*, new species.  
*Astrocoenia jamaicaensis*, new species.  
*Antillophyllia* (?) sp.  
*Antilloseris cantabrigiensis* (Vaughan, 1899).  
*Antilloseris jamaicaensis* (Vaughan, 1899).  
*Antilloseris* (?) sp.  
*Trochoseris* (?) sp.  
*Eupsammia clarendonensis*, new species.  
*Dendracis cantabrigiensis* Vaughan, 1899.  
*Actinacis sauckinsi*, new species.  
*Actinacis barretti*, new species.  
*Astreopora walli*, new species.  
*Goniaraea christianaensis*, new species.

<sup>1</sup> Not found in either the Trechmann or Matley collections and so not discussed in this paper.

CORALS FROM THE TRECHMANN AND MATLEY COLLECTIONS FROM  
THE UPPER CRETACEOUS OF JAMAICA

Family CARYOPHYLLIIDAE Verrill

Genus TROCHOCYATHUS Milne Edwards and Haime, 1848

TROCHOCYATHUS MATLEYI, new species

PLATE 2, FIGURES 5, 6

*Description.*—Corallum small, without basal attachment, trochoid, straight, tapering regularly to the base. Calice shallow, with rounded margin. Wall thin, solid, formed by septal thickening. Septa slightly exsert, 48 in number, thin, regularly arranged, equal near the wall, but only those of the first two cycles extending to the columella, where they are terminated by a crown of thin, elongate pali. Septa of the third cycle terminating with a crown of pali just outside of the first palar crown. Septa of the fourth cycle very short, extending inward but a short distance from the wall. Septal margins entire, sides granulate. Columella poorly developed, composed of one or two processes. Dissepiments absent. Costae low, equal, subacute, corresponding to the septa and extending to the base. No epitheca.

*Measurements.*—As follows:

Specimen	Height	Calicular diameter
	<i>Mm</i>	<i>Mm</i>
1 (type).....	3.5	4.0
2 (paratype).....	4.0	4.5
3 (paratype).....	4.2	4.5

*Type.*—U.S.N.M. no. 74478.

*Occurrence.*—In a hard, calcareous, blue concretionary mudstone 300 feet below the summit of Blue Mountain Peak, Jamaica (Matley collection).

*Remarks.*—This species is distinguished by its small size and need only be compared with *T. woolmani* Vaughan (1900a, p. 436) from the Upper Cretaceous of New Jersey, a species having an attached corallum and fewer septa. *Paracyathus* (?) sp. Trechmann is also an attached form and has a larger corallum.

## Family EUSMILIIDAE Verrill

## Genus DICHOCOENIA Milne Edwards and Haime, 1848

## DICHOCOENIA TRECHMANNI, new species

## PLATE 2, FIGURES 7, 8

*Description*.—Corallum massive, tuberous or bulbous in form. Corallites protuberant above the general surface to a height of 3 mm or more, originally cylindrical in form, but usually distorted by fission to an ovate or elliptical shape. Corallites united by costae and a well-developed exotheca; on the surface of the intercorallite areas the costae are distinct, their upper margins covered by single rows of granulations. Calices shallow, varying in diameter from 3 mm in the more circular ones to 3 by 4.5 mm in the more elongate and 3 by 7 mm in those undergoing fission. Septa thick, regularly alternate in size, slightly exsert, upper margins entire, lightly granulate laterally. In circular calices there are regularly three complete cycles, the first and second extending to the columella. In the distorted calices portions of the fourth cycle are often developed. Septa much thickened distally to form the corallite wall. Columella spongy, well developed but not prominent, and appearing lamellar in the elliptical calices. Endotheca not abundant.

*Measurements*.—As follows:

Specimen	Height	Maximum thickness
	<i>Mm</i>	<i>Mm</i>
1 (type).....	62	38
2 (paratype).....	70	44
3 (paratype).....	30	31

*Type*.—U.S.N.M. no. 74480.

*Occurrence*.—In the rudistid limestone of the Logie Green section; and in the limestones near Catadupa, Jamaica (Trechmann collection).

*Remarks*.—This species is particularly interesting because it extends the range of the genus *Dichocoenia* back into the Mesozoic in the West Indian region. It differs from *D. alabamensis* Vaughan (1900b, p. 139) from the Midwayan Eocene by the lack of development of the exotheca and the resulting close union of the corallites in the latter species. *D. tuberosa* Duncan (1863, p. 432) from the West Indian Miocene possesses pali and is a larger species. The living West Indian species, *D. stokesi* Milne Edwards and Haime,

has calices that project but slightly and are considerably elongated, with low, rounded, strongly echinulate costae, and pali before the first three cycles of septa.

*Stenosmilia* de Fromental (1870, p. 383), species of which occur in the Upper Cretaceous of Europe, is very close to, if not identical with, *Dichocoenia*. *D. trechmanni* closely resembles *S. proletaria* Oppenheim (1930, p. 437) from the Senonian of Austria (Gosau), but the costae are not so strong, the corallites are more protuberant, and the septa are more numerous in the Jamaican form.

### Family FAVIIDAE Gregory

#### Genus RHABDOPHYLLIA Milne Edwards and Haime, 1851

Gregory (1930, pp. 102-103) discusses the relationships of *Rhabdophyllia*, *Aplophyllia*, and *Cladophyllia* and finds that the only difference between the first two genera lies in the incomplete costae of the second as compared with the complete costae of *Rhabdophyllia*. He accordingly proposes to consider *Rhabdophyllia* a synonym of *Aplophyllia* d'Orbigny, 1849, because the latter has priority. Duncan (1884, p. 80) considered them identical but dropped d'Orbigny's name for the better known *Rhabdophyllia*. For the present, however, I should keep the two genera separate. *Rhabdophyllia* is very close to *Calamophyllia* but possesses a better-developed columella and lacks the accretion ridges or collarettes of the latter. The species described below has occasional encircling ridges resembling collarettes, but they lack the regularity of *Calamophyllia*.

#### RHABDOPHYLLIA QUAYLEI, new species

##### PLATE 2, FIGURES 3, 4

*Description*.—Corallites tall, cylindrical, or irregularly rounded in section, with an average diameter of 12.5 mm, dichotomous, increasing by fission, the new corallites projecting upward and outward at a slight angle from the parent corallites. Corallite walls solid, costate, without an epitheca. The costae alternate in size, corresponding to the septa, their margins being acute and granulate. The septa are variable in number within the calices because of fission but are more or less constant within the cylindrical corallites; in a calice measuring 9 by 17 mm there are 81; in a corallite measuring approximately 10 mm in cross section there are 60. They are about equal in thickness and regularly alternate in length, so that one-half of them extend to the center and unite with the columella. They are laterally granulate and are dentate on their upper margins. The columella is well developed, spongy, formed by the entangling of

the trabeculae of the inner ends of the septa. Endothecal dissepiments well developed.

*Type*.—U.S.N.M. no. 74481.

*Occurrence*.—Four specimens are from the base of the rudistid limestone, where it overlies the Trappean shales about midway between Cambridge and Catadupa in the railway cut, Jamaica (Trechmann collection).

*Remarks*.—This species is distinguished by the unusually large number of septa and relatively large corallites. It is close to *R. nutria* de Fromental from the Senonian of France, a species having slightly smaller corallites and fewer septa. Gerth (1928, p. 5) has described as *Rhabdophyllia* sp. a form from the Upper Cretaceous of Curaçao—from beds that he considers equivalent to those from which the present species comes—which may be very close to, or identical with, the present species, although he says that an inner (dissepimental) wall separates it from other Upper Cretaceous species of the genus.

#### Genus DICTUOPHYLLIA Blainville, 1830

##### DICTUOPHYLLIA CONFERTICOSTATA (Vaughan)

*Diploria conferticostata* VAUGHAN, 1899, p. 239, pl. 39, figs. 1-3.

*Leptoria conferticostata* VAUGHAN, 1919, p. 194.

*Leptoria conferticosta* FELIX, 1925, p. 90.

*Diploria crassolamellosa* DUNCAN, in Duncan and Wall, 1865, pp. 7, 12; 1868, p. 24.

*Ideotype*.—U.S.N.M. no. 74477.

*Occurrence*.—The four specimens in the Trechmann collection are from the following localities in Jamaica: Rudistid limestone, below Catadupa Station; limestone, Cambridge-Catadupa railway cut; dark limestone near igneous intrusion, Mooretown.

*Remarks*.—This species has been adequately described and figured by Vaughan (1899). The specimens from the Trechmann collection are in close accord with Vaughan's description and figures. They are all rounded, subglobose forms with the following measurements:

Specimen	Height	Length	Width
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	75	90	72
2.....	45	54	42
3.....	30	56	53
4.....	75	39	45

Vaughan noted a very close comparison between this species and *L. flexuossissima* (d'Achiardi) from the Eocene of San Giovanni



Ilarione, Italy, the main differences between the two being the wider valleys, equal septa, and knoblike fused inner ends of the septa on either side of the columella in the Eocene form; but it is probably more closely related to *L. reticulata* (Goldfuss) from the Maastrichtian of St. Petersburg, as it has been recently described and figured by Umbgrove (1925, pp. 107, 108). In this species the valleys are about 1 mm in width, with the same width for the collines, and the septa number 70 to 100 to the centimeter. *L. konincki* Milne Edwards and Haime and *L. delicatula* Reuss from the European Senonian are both separated from the Jamaican species by the lack of costate grooves between the walls.

### Family AGARICIIDAE Verrill

#### Genus TROCHOSERIS Milne Edwards and Haime, 1849

##### TROCHOSERIS CATADUPENSIS Vaughan

##### PLATE 2, FIGURES 9, 10

*Trochoseris catadupensis* VAUGHAN, 1899, p. 242, pl. 39, figs. 5, 6; 1919, pp. 194, 426.—FELIX, 1925, p. 120.

?*Trochosmia hilli* VAUGHAN, 1899, p. 233, pl. 36, figs. 1-4.

*Occurrence*.—Specimen 1 comes from the limestone near Catadupa; specimen 2, which possesses two calices, the result of budding, is from a locality near Catadupa; specimen 3 is from a shale that underlies the rudistid limestone and that is the equivalent of the Providence shales near Port Antonio, in the railway cut between Cambridge and Catadupa (Trechmann collection). Vaughan's type specimen came from near Catadupa.

*Remarks*.—Five specimens from the Trechmann collection are referred to this species. Three of them, mentioned above, fit Vaughan's description very well. Their measurements are as follows:

Specimen	Height	Basal diameter	Calicular diameters
	Mm	Mm	Mm
1.....	11.....	6.....	17 by 17.
2.....	20.....	7 by 9.....	14 by 17, 13 by 16.
3.....	16.....	7.....	14 by 21.5.
Vaughan's type.....	19.5.....	.....	13.5 by 15.

*Notes on other specimens*.—Two other specimens that almost certainly belong to this species are much larger and more mature forms. The following is a description of the better-preserved specimen:

The corallum is simple, arising from a small pedicellate base, rapidly expanding, the calice flaring out unequally with an undulate margin. The outer surface is covered to the base by low, acute costae, which regularly alternate in size, marked by single rows of granulations. The wall between them is imperforate and solid, its upper margin where it meets the reflexed calice. On one side of the corallum is attached a young compressed individual, which has been budded off. The calice is convex near the outer margin, but becomes deep and concave centrally, with a very small, deep fossette. The septa are very numerous, thin, crowded, irregularly arranged in six complete cycles and part of the seventh. They are solid, laterally granulated, lightly beaded on the upper edges, unequal in length and thickness. About 18 of the thickest and longest septa reach to the center of the fossette and join the columella. The columella is very small, deep in the fossette, with a papillose upper surface.

*Measurements.*—As follows:

Specimen	Height	Basal diameter	Calicular diameters
4.....	<i>Mm</i> 43	<i>Mm</i> 4	<i>Mm</i> 42 by 50
5.....	26	10	28 by 32

*Plesiotype.*—U.S.N.M. no. 74491.

*Occurrence.*—Specimen 4 comes from a locality near Catadupa; specimen 5 is from the equivalent of the Providence shales in the Cambridge-Catadupa railway cut (Trechmann collection).

*Remarks.*—The specimen just described is illustrated on plate 2, figures 9, 10.

A sixth specimen, referred with some doubt to this species, comes from the rudistid limestone in the Logie Green section. It differs from the other forms by the presence of an elongate columellar fossette, but in all other respects is like them. The corallum has been badly worn and measures 31 mm high and 37 by 63 mm in calicular diameters.

*Trochosmilia hilli* Vaughan may be a synonym of this species, although Vaughan points out that the sides of the costae are perpendicular and that the columella is absent, whereas in *Trochoseris catadupensis* the costae are acute or rounded. These are the only observable differences between the two forms. The columella in *T. catadupensis* is usually very small and deep in the calice and is rarely visible even in the larger specimens.

Genus *CENTRASTREA* d'Orbigny, 1849*CENTRASTREA HILLI*, new species

## PLATE 2, FIGURES 11, 12

*Description*.—Corallum thin, encrusting, 1 to 2 mm thick. The type specimen is 37 mm long and 21 mm wide. The corallites are small, short, and united by septo-costae, which are very short, thick, and rounded, and confluent between calices. The exotheca may fill the costal interspaces and give the appearance of a thick corallite wall when the specimen is worn. The calices are shallow, with an average diameter of 0.75 mm and a distance of 0.7 to 1 mm between centers. The septa are 12 in number, thick, laminar, and arranged in two cycles, the first of which reaches the center and joins the columella. They are much thickened near the calicular margins, and are united by a few synapticalae and well-developed endotheca. The columella is styliform, not prominent in the calices, and free within the corallites.

*Type*.—U.S.N.M. no. 74492.

*Occurrence*.—From a locality near Catadupa, Jamaica (Trechmann collection).

*Remarks*.—The single specimen upon which the foregoing description is based is a much-worn fragment, and the determination of the structure is very difficult.

This species is distinguished from other Upper Cretaceous species of the genus by the very small, close-set calices, and it seems to be nearer to the Neocomian species *C. microphyllia* d'Orbigny figured by de Fromental (1887, pl. 185, fig. 2). In that species, however, the septa number 16, octamerally arranged.

*VAUGHANOSERIS*, new genus

*Generic diagnosis*.—Corallum simple, free, low, and depressed-conical in shape, with a shallow circular or elliptical calice having a deep, elongate central columellar fossette. Septa laminar, imperforate, not uniting, lightly dentate on their upper margins, and laterally granulate. Wall indistinct, formed by synapticalae and endotheca, perforate. Septo-costae thin, beaded on their edges, united by exotheca and some synapticalae, covered by a very thin, easily eroded epitheca. Columella spongy, essential. Endotheca present. Synapticalae present, mostly near the wall.

*Genotype*.—*Vaughanoseris catadupensis*, new species, from the Upper Cretaceous near Catadupa, Jamaica.

*Remarks*.—Specimens of this genus, which groups with the Agariidae, look very much like young specimens of *Antillophyllia*, but the perforate wall and presence of synapticalae are indicative of its

fungid nature. It is most closely related to *Podoseris* Duncan, a genus possessing the same general structure but differing by being an attached form with uniting septa and a rudimentary papillary columella. It differs from *Antilloseris* Vaughan by having a thin epitheca, dissepiments, and a columella. *Microsmilia* Koby has a fasciculate columella, lacks dissepiments, has a folded or reflexed wall, as in *Trochoseris*, and is sessile in habit.

VAUGHANOSERIS CATADUPENSIS, new species

PLATE 3, FIGURES 11-13; PLATE 5, FIGURE 3

*Description*.—Corallum simple, low, depressed conical in shape, slightly elliptical in outline, with a small central, nipple-shaped scar of early attachment on the base. The exterior is partially covered by a thin epitheca, which is easily eroded away and through which the septo-costae are distinct. The septo-costae are acute, equal, thin, beaded on their edges, and united by a well-developed exotheca and a few synapticalae. The wall is indistinct, irregularly perforate, dissepimental in origin, and separated from the epitheca by the exotheca, which may be as much as 1 mm in thickness. The calice is shallow, with a central elongate columellar fossette. The septa are imperforate, exsert, laminar, straight, not uniting inwardly, and arranged in 6 complete cycles (192 septa). Those of the first and second cycles are equal, lightly dentate on their upper margins, laterally granulated in close vertical rows and extending to the columella. The remaining septa are regularly shorter and thinner according to their cycle, with their upper margins notched by strong teeth. The columella is spongy, well developed, filling the bottom of the fossette. The synapticalae are not numerous, occurring mostly near the wall. Endotheca present but not abundant.

*Measurements*.—As follows:

Specimen	Height	Calicular diameters	Depth of fossette
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	15	30 by 32	3.8
2 (paratype).....	13	28 by 31	4.2

*Type*.—U.S.N.M. no. 74485.

*Paratype*.—U.S.N.M. no. 74486.

*Occurrence*.—Specimen 1 is from a locality near Catadupa; specimen 2 comes from the equivalent of the Providence shales underlying the rudistid limestone in the Cambridge-Catadupa railway cut (Trechmann collection).

## FAVIOSERIS, new genus

*Generic diagnosis.*—Corallum massive, tuberous, pedunculated. Corallites slightly protuberant, cylindrical, or deformed by fission, united by septocostae. No true corallite wall, but a ring of well-developed synapticalae forms a perforate boundary. Septa thin, imperforate, laminar, beaded on the upper edges, thickened peripherally near the thecal ring, continuous with the septocostae, which are trabeculate and perforate, the perforations tending to become filled up. The upper edges of the costae are rounded and beaded. Columella absent, the axial space being quite empty. Dissepiments not well developed. Reproduction by fission.

*Genotype.*—*Favioseris anomalos*, new species, from the Upper Cretaceous limestones of Jamaica.

*Remarks.*—The family position of this genus is somewhat uncertain because its general features are those of the Oulastreids, although the septal structure is close to the Anabaciids in spite of the laminar septa, which are more characteristic of the Agariciids. The Oulastreids, however, increase by gemmation, whereas fissiparity is very marked in *Favioseris*. The laminar condition of the septa seems to be due to subsequent filling of the original perforate trabecular framework—a process that has not proceeded so far in the septocostae as in the septa. No genus of the Anabaciidae seems close to this form. *Siderofungia* Reis is perhaps related, but the walls of that genus are very poorly developed and the calices have the habit of *Siderastrea*. *Crateroseris* Tomes is supposed to have imperforate septa and septocostae and therefore groups with the Agariciidae, but, as Gregory (1900, p. 189) has pointed out, this apparent imperforate condition may be quite the opposite, in which case *Crateroseris* would be near *Dimorpharaea* and *Polyphyllastrea*. *Crateroseris* as it is now understood is near *Favioseris*, except that it increases by gemmation and has more protuberant corallites. For the present *Favioseris* is placed in the Agariciidae.

## FAVIOSERIS ANOMALOS, new species

## PLATE 4, FIGURES 19, 20

*Description.*—Corallum massive, tuberous, arising from a narrow base. The calices are slightly protuberant, not bounded by a true corallite wall, the margins being formed by the thickened outer ends of the septa and a ring of synapticalae, as in the Oulastreids and *Siderastrea*. They are originally circular in outline but are usually oval or elliptical, owing to the fissiparous mode of increase. The diameter of the circular calices averages 3 mm, that of the elongate

ones 2.5 by 4.5 mm. Within the calices the septal margins fall evenly but steeply to the central fossette, the bottom of which is about 1.2 mm below the calicular margins, or 1 mm below the intercorallite areas. The surface between the corallites averages 1.5 mm in width and is crossed by the confluent septocostae, whose upper margins are heavily beaded, owing to their trabeculate-fenestrate structure. The septa are imperforate, laminar, thickened peripherally, thinner toward the center, not extending to the center of the corallite, and laterally granulated with the upper margins dentate. In a circular calice there are regularly 24 septa, 12 of which are longer than the rest and reach to the edge of the fossette, which they bound; in larger calices up to 45 septa can be counted, all regularly alternating in length. There is no columella. The synapticulae are developed only in the peripheral region of the corallites. Between corallites there is some exotheca but there is no endotheca within them.

*Measurements.*—The holotype is 55 mm high, 32 mm in maximum diameter, and 16 mm in diameter near the base.

*Holotype.*—U.S.N.M. no. 74484.

*Occurrence.*—In the limestones near Catadupa, Jamaica (Trechmann collection).

*Remarks.*—This species may be distinguished from *Synastraea* (?) *adkinsi* by its imperforate septa, by the presence of a synapticular corallite wall, and by the fissiparous mode of increase.

## Family LEPTOPHYLLIIDAE Vaughan

### Genus DIPLARAEA Milaschewitsch, 1876

#### DIPLARAEA (?) BOLTONAE, new species

#### PLATE 2, FIGURES 1, 2

*Description.*—Corallum subcylindrical, compressed near the base, expanding upwardly, subdividing into several corallites, which remain closely united in a single series, separated by constrictions of the corallite wall and joined inwardly by short, confluent septocostae. Between the base and top of the corallum the exterior is marked by irregular expansions, and in the type specimen midway between base and top is a small protuberant corallite that has been produced fissiparously and has remained separate. The exterior is covered by a very thin, easily eroded epitheca, through which the septo-costae are seen. The latter are rounded, subequal, and beaded on their edges. Between them and extending to the wall are well-developed exothecal dissepiments. The wall is perforate, indistinct, and composed of synapticulae and dissepiments. The calices are shallow and very irregular in outline. There are three on the top

of the type, serially arranged, united directly by the septo-costae, any intercorallite wall being absent. The septa are slightly exsert, laminar, irregularly perforate as in *Leptophyllia*, thin, equal, laterally granulated, united by endotheca and synapticulae. In one calicular center, 8 by 10 mm, there are 60 septa, all of which extend to the columella. The columella is parietal, moderately developed, spongy in appearance in the calices but not prominent when seen in cross section.

*Measurements.*—The holotype measures: Height, 42 mm; basal diameters, 8 by 10 mm; diameters 10 mm below calices, 12 by 23 mm; length and width of series, 29 by 6-12 mm.

*Holotype.*—U.S.N.M. no. 74479.

*Occurrence.*—From a locality near Catadupa, Jamaica (Trechmann collection).

*Remarks.*—This species fits the generic characters of *Dermosmilia* as discussed by Koby (1889, p. 546). Ogilvie (1897, p. 258) later considered Koby's genus a synonym of *Diplaraea*. Koby does not mention the condition of the wall in *Dermosmilia*, but Ogilvie states that a true wall is not present, but that septal thickening and exothecal development form an outer wall. In the present species the septal thickening is not apparent, the septa being of nearly equal thickness throughout, and the entire structure of the corallum is like *Physoseris* Vaughan (1905, p. 396), except for the colonial form of the corallum. All the species at present referred to *Diplaraea*, except *D. venezuelensis* Gregory, are from the Upper Jurassic, although its nearest relation, *Haplaraea* Milaschewitsch, a solitary form, occurs also in the Senonian of Europe (Oppenheim, 1930, p. 26 ff.). *D. venezuelensis* Gregory (1927, p. 441), from the Urgonian of eastern Venezuela, is a species with larger branches and more septa, only a part of the latter, however, reaching to the columella.

## Family ANABACIIDAE Duncan

### Genus CYCLOLITES Lamarck, 1801

#### CYCLOLITES JAMAICAENSIS, new species

#### PLATE 3, FIGURES 1-4

*Description.*—Corallum simple, free, circular or slightly elliptical in outline, flat on the base or slightly concave, convex above, with a circular fossette 2 to 3 mm in depth. Wall of corallum horizontal, indistinct. The base is covered by a thick, concentrically wrinkled epitheca. The septa are numerous, thin, straight, not uniting, trabeculate, and fenestrated, those of the first three cycles, which

are slightly thicker than the rest, being almost imperforate and laminar, owing to the filling up of the pores. In mature specimens there are six complete cycles of septa and a good part of the seventh. There is no columella. The synapticulae are well developed, particularly in the lower part of the corallum.

*Measurements.*—As follows:

Specimen	Height	Basal diameters
	<i>Mm</i>	<i>Mm</i>
1 (paratype).....	6	23 by 27
2 (paratype).....	9	24.5 by 28
3 (paratype).....	11.5	31 by 34
4 (paratype).....	16	32 by 33.5
5 (type).....	14	28 by 28.5
6 (paratype).....	13	22.5 by 26
7 (paratype).....	11	22 by 23

*Type.*—U.S.N.M. no. 74488.

*Occurrence.*—All the specimens come from the Providence shales at Providence, near Port Antonio, Jamaica (Trechmann collection).

*Remarks.*—This is the first species of this important and widespread Cretaceous genus to be noted from the West Indian or North American areas. It groups with *C. hemisphaerica* Michelin (*non* Lamarck, 1801)<sup>3</sup> of the Senonian of Europe, and is most closely related to *C. ligeriensis* Milne Edwards and Haime (Fromentel, 1870, p. 360) from the French Senonian, and from which it may be distinguished by its larger number of septa (about 124 in *C. ligeriensis*, *fide* de Fromentel; 192 to 250 in *C. jamaicensis*), coralla of about the same size.

#### PARACYCLOSERIS, new genus

*Generic diagnosis.*—Corallum simple, free with scar of early attachment, depressed-conical to plano-convex in shape, circular in outline, the lower surface covered by a strong, concentrically wrinkled epitheca. Calice shallow or superficial, the latter condition occurring in younger specimens, with an oval or elongate fossette. Wall of corallum indistinct. Septa numerous, uniting as in *Cycloseris*, trabeculate-fenestrate in structure, usually with the pores well filled, particularly in the larger septa, upper edges marked by strong, almost lacerate teeth. Columella strong, well developed, essential, composed of numerous papillae. Synapticulae present

<sup>3</sup> Milne Edwards and Haime, aware that this species was not identical with Lamarck's species, placed it in the synonymy of *C. discoidea* (Goldfuss), but Felix, in 1903, pointed out that it does not belong to Goldfuss' species and retained Michelin's name for it. Oppenheim, in 1930, proposed the name *C. michelini* for the species.



within the corallum near the edges of the calice. Dissepiments absent.

*Genotype*.—*Paracycloseris elizabethae*, new species, from the Upper Cretaceous of Jamaica.

*Remarks*.—The septal arrangement of this form is distinctive and much the same as that of many species of *Fungia* (*Cycloseris*-form). The septal structure is no less distinctive—the septa of the lower cycles are very similar to the laminar septa of the Agariciids except for the large teeth, which are of a type more often found in the Fungiids. The relationship with the Anabaciidae is shown in the structure of the septa of the higher cycles—the trabeculate-fenestrate or latticework arrangement of the trabeculae characteristic of *Anabacia* and *Microsolena*. The genus is not, however, closely related to any of the simple genera of this family, except *Cyclolites*, from which it is distinguished by the presence of a well-developed columella and less perforate, uniting septa. *Anabacia* lacks an epitheca and a columella, as does also *Trochoplegma*. *Trocharaea* has a parietal columella but no epitheca.

This form may be intermediate between the Mesozoic Cyclolitids and the modern Fungiids, possessing as it does many of the characters of both *Cyclolites* and *Cycloseris*.

PARACYCLOSERIS ELIZABETHAE, new species

PLATE 3, FIGURES 5-10; PLATE 5, FIGURES 1, 2

*Description*.—Corallum simple, free, circular in outline, flat or convex on the base, convex or concavo-convex above, with a shallow elliptical fossette in the more mature specimens. The lower surface is covered by a stout, concentrically wrinkled epitheca, to the central point of which, in the smaller specimen, is attached a foraminifer. The septa are numerous, upwardly arched, uniting, mainly imperforate with the upper margin dentate, laterally spinulose or granulate. There are six complete cycles and part of the seventh. Those of the first two cycles are equal, much thicker than the rest, extending to the columella, their upper edges set with coarse, lacerate, multitrabeculate teeth, which increase in size toward the center. The septa of the third cycle, while prominent, are much smaller than those of the first two, their upper edges being set with smaller teeth, but they extend to the columella. The arrangement of the remaining cycles is distinctive. The septa of the fourth cycle, instead of being inwardly fused to those of the *third*, are fused to the septa of the *fifth* cycle, which are nearest the primaries and secondaries, and the remaining septa of the fifth cycle join those of the fourth near the latter's junction with the first set of septa

of the fifth; the inner ends of the fifth cycle—that is, those nearest the primaries and secondaries—are fused to the third cycle near the columella; the sixth cycle fuses to the fifth, and those of the seventh, which are developed near the primaries, fuse to the sixth. The structure of the septa is trabeculate-fenestrate, the pores being filled up below, and perforations, except of the upper parts of the septa of the higher cycles, are rare. The columella is well developed, essential, elongate, completely filling the fossette, with a papillose upper surface. Synapticulae are present mainly in the peripheral region. The wall is indistinct. There are no dissepiments.

*Measurements.*—As follows:

Specimen	Height	Diameter	Depth of fossette
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	10	29.5	2.7
2 (paratype).....	3.5	26	0

*Type.*—U.S.N.M. no. 74489.

*Occurrence.*—From a locality near Catadupa, Jamaica (Trechmann collection).

*Remarks.*—Specimen 2 is an immature one, in which the corallum is discoid or plano-convex (pl. 3, figs. 8, 9); the septa are much thinner and more finely denticulate than in specimen 1, upon which the foregoing description was mainly based.

#### Genus SYNASTREA Milne Edwards and Haime, 1848

SYNASTREA (?) ADKINSI, new species

#### PLATE 3, FIGURES 14, 15

*Description.*—Corallum massive, tuberous, increasing in size by superposition of concentric layers about 5 mm thick, the exposed margins of these layers being covered by a thin epitheca. The calices are distinct, close-set, nearly always separated by an intercorallite groove. Where they are separated to any extent they are circular in outline, where close-set they are polygonal. The average diameter within the margins is 2.75 mm; the distance between centers varies from 5 to 6.5 mm; the maximum height of the margins above the intercorallite grooves is about 0.3 mm; the average calicular depth is 0.75 mm, but is often increased by weathering. There is no corallite wall, and the septocostae are confluent. The septa, 40 to 60 in number, comprise four complete cycles and parts of the fifth. In structure they are trabeculate-fenestrate near the surface,

becoming more or less filled up below and appearing lamellar in longitudinal section as the trabeculae lose their individuality. The septa of the first two cycles are much thicker and more prominent than the rest. The columella is well developed, spongy, and papillose on the surface. The dissepiments are absent, but there is a great development of the synapticalae.

*Measurements*.—Corallum measures: Height, 51 mm; diameter near base, 15 mm; maximum diameter between base and upper surface, 32 mm.

*Holotype*.—U.S.N.M. no. 74483.

*Occurrence*.—Upper Cretaceous limestone in the railway cut between Cambridge and Catadupa, Jamaica (Trechmann collection).

*Remarks*.—The calicular surface of this species closely resembles the typical Anabaciids, but the change in the structure of the septa from trabeculate-fenestrate to more or less laminar is very pronounced, resembling the structure found in *Astraraea* Felix, but the wall of the corallum in this genus is solid, imperforate, and costate (as it is in *Trochoseris* Milne Edwards and Haime); at least this is true of specimens labeled *Astraraea media* in the National Museum in a collection of the Gosau corals from Prof. Felix. *Synastrea agaricites* (Goldfuss), type of the genus, also from the Gosau beds, specimens of which are in the National Museum, agrees more nearly with *adkinsi* from the standpoint of structure and character of the exterior, although the filling up of the lower parts of the septa is not so pronounced. The distinct calices of this species also distinguish it from other species of *Synastrea*, most of which have shallow calices not bounded by a distinct groove, as in *Thamnasteria* Lesauvage.

### Family OULASTREIDAE Vaughan

#### PRODIPLOASTREA, new genus

*Generic diagnosis*.—Corallum massive, astreiform, forming a rounded pedunculate mass. Corallites cylindrical, of medium size, projecting slightly above the common surface, united by confluent septo-costae and a thin, well-developed exotheca. Septa not numerous, thin, little exsert, not uniting, continuous with the septo-costae, laminar in structure, very little perforate, and lightly dentate on the upper edges. Corallite wall porous, synapticular in origin. Synapticalae poorly developed except in the thecal ring. Endotheca scanty. Columella absent or very rudimentary. No pali.

*Genotype*.—*Prodiploastrea schindewolfi*, new species, from the Upper Cretaceous of Jamaica.

*Remarks.*—This genus is created to receive a species from the Trechmann collection that is closely related to *Diploastrea* Matthai, *Oulastrea* Milne Edwards and Haime, and *Cyathomorpha* Reuss, but which differs from all these, as well as from *Brachyphyllia* Reuss and *Pseudofavia* Oppenheim, by the lack of a well-developed columella. A more or less well-developed essential columella is present in the five genera mentioned. The septa and septo-costae are also unusually thin and comparatively few in number for members of this family, and there is but a slight thickening of the septa in the vicinity of the walls. The condition of the upper edges of the septa is not well shown in the specimen, but the septa are lightly dentate and lack pali or paliform lobes such as are found in *Cyathomorpha* and *Oulastrea*. *Diploastrea* has strong septal teeth or notches, but lacks pali. *Brachyphyllia* has numerous septa, which unite or fuse inwardly, and a well-developed columella.

PRODIPLOASTREA SCHINDEWOLFI, new species

PLATE 4, FIGURES 21, 22

*Description.*—Corallum subspherical, pedunculate. Corallites cylindrical, projecting, united by confluent septo-costae and a thin exotheca. On the surface between the corallites the septo-costae are thin, wavering, with rounded beaded edges. The calices are circular, bounded by a thin, well-defined, perforate synapticular wall, rather deep, crateriform, with an average diameter of 3.5 mm, although they may be as small as 2.5 mm. They are but slightly elevated above the intercorallite areas on the upper surface of the corallum, becoming higher on the sides and toward the base, the average distance between them being 3.25 mm. The septal arrangement is irregular, there being 24 to 32 septa, depending on the size of the corallite. They are thin, laminar, imperforate, regularly alternating in length so that half of them extend nearly to the center of the corallite, slightly exsert, lightly dentate on their upper margins, which descend rapidly to the bottom of the calice. There is no true columella, although the inner edges of a few of the larger septa may meet to form a straggly parietal axis. Endotheca scarce. Synapticalae well developed only near the wall. Exotheca well developed.

*Holotype.*—U.S.N.M. no. 74476.

*Occurrence.*—In the limestone of the Upper Cretaceous in the Cambridge-Catadupa railway cut (Trechmann collection).

## Family ACROPORIDAE Verrill

## Genus MULTICOLUMNASTRAEA Vaughan, 1899

## MULTICOLUMNASTRAEA CYATHIFORMIS (Duncan)

*Heliastrea exsculpta* DUNCAN (*non* Reuss), in Duncan and Wall, 1865, pp. 7, 8, 11; 1868, p. 24.

*Heliastrea cyathiformis* DUNCAN, in Duncan and Wall, 1865, pp. 7, 8, pl. 1, figs. 1a, b; 1868, p. 24.

*Multicolumnastrea cyathiformis* VAUGHAN, 1899, p. 236, pl. 38, fig. 1; 1919, pp. 194, 486.—FELIX, 1925, pp. 252-253.

*Occurrence*.—In the rudistid limestone in the Logie Green section, Jamaica (Trechmann collection).

*Remarks*.—One very poorly preserved specimen from the Trechmann collection is referred to this species. It is a low-branching corallum with short stubby branches, which are usually compressed, with average diameters of 8 by 10 mm, closely packed together. The corallites are somewhat smaller than in the specimens described by Vaughan. Vaughan gives an average diameter of 2 mm, whereas in the specimen examined by the author they are rarely more than 1.25 mm. The intercorallite areas are crossed by the septo-costae when the corallites are close together; when they are distant the costae merge into a porous, reticulated coenenchyme.

Gerth (1928, p. 3) has described a species of this genus, *M. parvula*, from the Upper Cretaceous of Curaçao, which has calices not over 1 mm in diameter.

Vaughan (1919, p. 486) states that *Multicolumnastrea* is very close to *Actinaxis*, the main point of distinction being the presence of several coarse columellar tubercles in the former.

## Family PORITIDAE Dana

## Genus GONIOPORA Blainville, 1830

## GONIOPORA REUSSIANA (Duncan)

## PLATE 4, FIGURE 18; PLATE 5, FIGURES 4, 5

*Porites reussiana* DUNCAN, in Duncan and Wall, 1865, p. 8, pl. 1, fig. 2; 1868, p. 25.—VAUGHAN, 1899, p. 249.

*Goniopora jamaica* 1 BERNARD, 1906, p. 159.

*Plesiotype*.—U.S.N.M. no. 74490.

*Occurrence*.—In the Upper Cretaceous limestones in the Cambridge-Catadupa railway cut, Jamaica (Trechmann collection).

*Remarks*.—One specimen from the Trechmann collection is a good example of this poorly known species. The form of the corallum and size of the calices agree well with Duncan's description.

Vaughan (1899), after repeating Duncan's original description, adds:

The usual number of cycles of septa is three; the arrangement into cycles does not appear perfectly regular and uniform, so Duncan's figures must be used with a qualification. In the best preserved portions there is no granulate area on the summit of the wall between the ends of the septa. Apparently the upper edge of the wall is acute in perfect material. Diameter of the calices 2.5 to 4 mm; the usual diameter is slightly less than 3 mm. The specimen does not permit the details of the pali (?) to be made out. It seems quite probable that the species is a *Litharaea*, and not *Porites*.

Bernard in his discussion (1906) adds practically nothing to our knowledge of this species, but questions whether the supposed type in the Museum of the Geological Society of London is the same as the specimen figured and described by Duncan in 1865, adding (p. 160): "There is not a character in the drawing [Duncan's] which agrees in the remotest with the calices of the specimen."

Details regarding the structure of this species can now be added from the well-preserved specimen in the Trechmann collection. The walls between the calices, where they are acute, are marked by a single row of granulations, but where there is some separation, the walls are rounded and may have 2 to 4 rows of granules. The septa are almost always 20 in number, arranged in a modification of the typical septal formula of the recent members of the genus that have 24 septa, as it is given by Bernard (1903, p. 21); this is best explained by plate 5, figures 4 and 5, representing the formulas of recent *Goniopora* and *G. reussiana*. There are three trabecular elements between the wall and a palus. There are five tubercular pali. The columella consists of a single tubercle surrounded below the floor of the calice by a ring of synapticalae uniting the palar trabeculae. The under surface of the corallum, where exposed by the superposed, laminar growth layers, is covered by a thin epitheca.

*Measurements.*—The diameters of the branches of the specimen are 12 by 15, 11 by 13, and 11 by 15 mm.

GONIOPIORA TRECHMANNI, *n. sp.*

PLATE 3, FIGURES 16, 17

*Description.*—Corallum massive, with a flat or concave base, growing upward by the addition of superimposed layers into a hemispherical or subspherical mass. The corallites average 1.8 mm in diameter and are embedded in a porous reticulate coenenchyme 0.5 to 1.5 mm apart. There is no definite corallite wall, and the outer ends of the septa merge with the coenenchyme. The calices are polygonal in outline, of moderate depth, bounded by a rounded reticular intercalicular ridge. The septa are well developed, always

12 in number near the columella, but frequently branching near the periphery so that the original number of septa may have been as many as 18. They are equal in size, thin, irregularly perforated, with their inner ends ending abruptly, leaving an axial space about 0.5 mm in diameter, which is partially filled by a weak, lax columella formed by a few straggling rods and attached to the inner ends of the septa. The interseptal loculi are mostly open. The upper margins of the septa are dentate. No pali can be discerned.

*Measurements.*—As follows:

Specimen	Height	Basal diameter	Maximum diameter
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	71	31 by 45	40 by 50
2 (paratype).....	20	20 by 21	.....
3 (paratype).....	22	9 by 12	19 by 24

*Type.*—U.S.N.M. no. 74482.

*Paratype.*—U.S.N.M. no. 74493 (specimen 2).

*Occurrence.*—The type comes from a limestone in the Cambridge-Catadupa railway cut (Trechmann collection). Specimen 2 is from the *Actaeonella* beds east of Smithville (Matley collection). Specimen 3 is from the Providence shales, underlying the rudistid limestone, at Providence, near Port Antonio, Jamaica (Trechmann collection).

*Remarks.*—Worn specimens of this species look very much like *Actinacis*, but the polygonal, nonexsert calices, as well as the structural features, indicate a position in *Goniopora*, the number of septa removing it from *Porites*. The species, however, shows few affinities with the Senonian and Maastrichtian species of *Goniopora* (*Litharaea*), nor is it related to *G. reussiana* (Duncan), from which it can be distinguished by its smaller calices and fewer septa, with apparently no pali. It is probably nearer to the species enumerated from the Cenomanian of Bohemia by Bernard (1903, pp. 126, 128). A summary of the salient features of these forms, together with the Jamaican species, follows:

Species	Diameter of calices	Number of septa	Pali
	<i>Mm</i>		
<i>G. michelini</i> (Reuss).....	1.3	12-24	Not true pali.
<i>G. textilis</i> (Poëta).....	2.0	18-20	3-6, irregular.
<i>G. trechmanni</i> , new.....	1.8	12-18	None?

CORALS FROM THE TRECHMANN COLLECTION FROM THE LOWER  
EOCENE RICHMOND FORMATION OF JAMAICA

Genus *STYLOPHORA* Schweigger, 1819

*STYLOPHORA* species a

*Specimen*.—U.S.N.M. no. 44281.

*Occurrence*.—The specimen, which has been rolled, comes from the conglomerate of the Richmond beds at Port Maria and may be derived Cretaceous (Trechmann collection).

*Remarks*.—One specimen, while it undoubtedly represents a new species, is not named at present because of the imperfect state of the material. It is a curved subcylindrical fragment of a branch, 41 mm in length, with diameters of 15 by 17 mm. The surface is much worn, and the characters of the calices and surface of the coenenchyme cannot be determined. The corallites are small, averaging 0.75 mm in diameter, distant 0.5 to 1 mm. Septa, 6 in number, attached to the columella; secondaries obsolete or not preserved in the specimen. The columella is large, styliform, and much thickened below the bottom of the calice. Coenenchyme dense.

*STYLOPHORA* (?) species b

*Specimen*.—U.S.N.M. no. 44282.

*Occurrence*.—The specimen occurs with the preceding one, in the conglomerate of the Richmond beds at Port Maria, Jamaica (Trechmann collection).

*Remarks*.—Another fragment from the Trechmann collection is placed with some doubt in this genus. It is part of a flattened branch or expansion of a corallum, 17 mm wide, 23 mm long, and 5 mm thick. The surface is badly worn. The corallites range from 0.75 to 1 mm in diameter, bounded by a solid costulate wall. Septa, 12 in number, 6 of them rudimentary, the rest well developed and reaching to the columella. Columella styliform, small. The costae merge with a porous, reticulate coenenchyme, which is divided by a ridge extending midway between the corallites.



CORALS FROM THE TRECHMANN AND MATLEY COLLECTIONS  
FROM THE MIDDLE EOCENE YELLOW LIMESTONE OF JAMAICA

Family SERIATOPORIDAE Milne Edwards and Haime

Genus STYLOPHORA Schweigger, 1819

STYLOPHORA CAMBRIDGENSIS, new species

PLATE 4, FIGURES 3, 4

*Description.*—Corallum branching, basal portion unknown. Branches small, compressed or cylindrical. Calices small, superficial, ranging in diameter from 0.75 mm in the younger ones to 1 mm in older calices, spaced 0.25 to 0.5 mm apart. Septa, 12 in number, the six primaries distinct, well developed, extending to the columella, equal in size, and often exsert above the calicular margins; secondaries very short or rudimentary, present as mere ridges in the younger corallites. The columella is small, styliform, tubercular, not attaining the same height as the upper margins of the primary septa. The coenenchyme is dense, its surface covered with small tubercular granulations, which may be so arranged as to form an indistinct median ridge. The size of the branches varies from a diameter of 6.5 mm, in the more cylindrical ones, to 6 by 10 and 9 by 11 mm, in the more compressed ones.

*Type.*—U.S.N.M. no. 44283.

*Occurrence.*—The five specimens come from the Yellow limestone in the Cambridge district (Trechmann collection).

*Remarks.*—This species is closely related to *S. compressa* Duncan (1873, p. 551), a species occurring in the upper Eocene of St. Bartholomew, and may be possibly only a variety, but the more closely set, nonsalient calices, separated by a more strongly granular coenenchyme with a faint median ridge, appear sufficient to separate this Jamaican form.

Duncan (1865, p. 8) identified a *Stylophora* from the Richmond beds of Port Maria with *S. contorta* (Leymerie), a European species, which might be the same as the present species, but it is certainly not identical with Leymerie's species as it is described by Milne Edwards and Haime (1857, p. 135). Duncan's specimen might also be identical with our *Stylophora* species a, which comes from the same horizon at the same locality.

## Family ASTROCOENIIDAE Koby

Genus ASTROCOENIA Milne Edwards and Haime, 1848

ASTROCOENIA JAMAICAENSIS, new species

## PLATE 4, FIGURE 12

*Description.*—Corallum more or less massive, upper surface irregularly convex, sending up short protuberances. Corallites polygonal, closely fused by their walls in the lower part of the corallum, but often becoming slightly separated and cylindrical on the apices of the protuberances. Calices shallow, polygonal or circular in shape, separated by the fused corallite walls on which the upper ends of the septa of adjoining calices meet, producing low granulations or spines. Septa, 20 in number; 10 much larger than the rest and extending to the columella, the others more or less rudimentary. They are slightly granulate laterally, and the upper margins, which slope at first gently, then abruptly, toward the columella, are very lightly dentate. The columella is styliform, appearing in the bottom of the calice as a round or slightly compressed tubercle. Dissepiments sparsely developed.

*Measurements.*—As follows:

Specimen	Length	Width	Height	Calices	
				Maximum diameter	Minimum diameter
1 (type).....	<i>Mm</i> 83	<i>Mm</i> 59	<i>Mm</i> 50	<i>Mm</i> 4	<i>Mm</i> 2
2 (paratype).....	15	13	22	4	2
3 (paratype).....	20	12	32	3	2

Specimen 1 represents a nearly complete corallum, whereas 2 and 3 are protuberances from a larger specimen.

*Type.*—U.S.N.M. no. 44284.

*Occurrence.*—Specimen 1 comes from the *Velates schmiedeliana* bed of the Cambridge formation at Spring Mount; specimens 2 and 3 are from the Yellow limestone in the Cambridge district (Trechmann collection).

*Remarks.*—This species is readily distinguished from the other species of this genus of the West Indian Tertiary, except *A. decaturensis* Vaughan (1919, p. 348) (lower and middle Oligocene), by the constant decamerall arrangement of the septa. In *A. decaturensis* the arrangement is usually octamerall, as in the other species of the West Indies, but it may be decamerall occasionally. Comparison with some other decamerall species follows:

Species of <i>Astrocoenia</i>	Horizon	Locality	Diameter of calices	Septa
<i>blanfordi</i> Duncan .....	Lower Eocene.....	Sind.....	<i>Mm</i> 2 -4.5	10/10
<i>clautensis</i> Dainelli.....	Eocene.....	Italy.....	2.5-3.5	10/10
<i>spongilla</i> Oppenheim.....	Middle Eocene.....	Bosnia.....	1 -2	10/10
<i>jamaicaensis</i> , new.....	do.....	Jamaica.....	2 -4	10/10

### Family FAVIIDAE Gregory

Genus ANTILLOPHYLLIA Vaughan, 1932 (=ANTILLIA of authors)

ANTILLOPHYLLIA (?) species

*Specimen*.—U.S.N.M. no. 44285.

*Occurrence*.—In the Yellow limestone at Spice Grove, Manchester Parish, Jamaica (Matley collection).

*Remarks*.—A single poorly preserved specimen is very doubtfully referred to this genus. It is a large corallum, subcylindrical or subcornute, curved, measuring 65 mm in length, with a maximum diameter near the top of 43 mm. The calice is filled with a tough matrix, and the upper edges of the septa are concealed for the most part, although a portion of one appears to be dentate, but the characters of the dentations cannot be determined. The exterior is devoid of an epitheca, which may have been worn away, and the costae, united by some exotheca, alternate in size and appear to be granulate or beaded on their edges. The wall is not distinct but is apparently solid. The septa are of medium thickness, laminar, imperforate, 90 to 100 in number, half of them extending to the center, where they unite with the large spongy columella. Endotheca abundant.

### Family AGARICIIDAE Verrill

Genus ANTILLOSERIS Vaughan, 1905

ANTILLOSERIS CANTABRIGIENSIS (Vaughan)

*Turbinoseris cantabrigiensis* VAUGHAN, 1899, p. 245, pl. 40, figs. 5-7.

*Antilloseris cantabrigiensis* VAUGHAN, 1919, p. 194.—FELIX, 1925, p. 144.

*Idiotypes*.—U.S.N.M. no. 44286.

*Occurrence*.—In a bed of small corals in the Yellow limestone in a road cut on the Rock River main road near Beckford, Clarendon Parish, Jamaica (Matley collection).

*Remarks*.—Twenty specimens from the Matley collection have been identified by Dr. Vaughan with his species. Their measurements are as follows:

Specimen	Height	Maximum diameters
	<i>Mm</i>	<i>Mm</i>
1.....	9.0	6.5 by 7.0
2.....	11.5	8.0 by 8.5
3.....	17.0	6.5 by 10
4.....	18.5	8.0 by 9.5
5.....	20.5	9.0 by 10
6.....	21.0	7.0 by 8.0
7.....	22.0	8.0 by 9.0
8.....	23.0	6.0 by 11.5
9.....	25.0	6.0 by 9.0
10.....	25.5	9.5 by 11.0
11.....	26.5	9.0 by 10.0
12.....	28.0	6.0 by 10.0
13.....	27.0	7.5 by 10.5
14.....	28.5	7.5 by 9.5
15.....	27.5	10.0 by 11.5
16.....	39.0	10.0 by 11.0
17.....	22.5?	6.0 by 11.0
18.....	24.0?	9.0 by 12.0
19.....	26.0?	9.0 by 10.5
20.....	22.5?	9.0 by 12.0

(The last four specimens are imperfect, the bases having been broken off.)

From this tabulation it will be seen that in this species lateral growth ceases after a maximum diameter of 9–10 by 10–11 mm has been reached, although the height may extend to as much as 39 mm. (Those specimens having diameters greater than the maxima recorded have been laterally compressed and distorted.)

#### ANTILLOSERIS JAMAICAENSIS (Vaughan)

*Turbinoseris jamaicaensis* VAUGHAN, 1899, p. 246, pl. 40, figs. 8–10.

*Antilloseris jamaicaensis* VAUGHAN, 1919, p. 194.—FELIX, 1925, p. 144.

*Homeotype*.—U.S.N.M. no. 44287.

*Occurrence*.—In the Yellow limestone on the Nottingham road near the turn to Gentle Hill, Manchester–St. Elizabeth boundary, Jamaica (Matley collection).

*Remarks*.—One specimen is referred to this species. It is considerably larger than Vaughan's figured specimen but fits his description of the internal structure well. It is much larger than any of the specimens referred to *A. cantabrigiensis* and measures: Height, 47 mm; maximum diameters, 14.5 by 17.5 mm.

#### ANTILLOSERIS species

#### PLATE 4, FIGURES 8–10

*Description*.—Corallum simple, short, conical, slightly compressed. Calice deep. Exterior of corallum costulate and devoid of an epi-

theca. Wall indistinct, perforate, and synapticate. Septa numerous, thin, imperforate, in five complete cycles and part of the sixth, the fifth and sixth cycles often uniting, the rest free at their inner ends, their upper margins with prominent dentations and their sides granulate, united by numerous synapticae. The septa of the first two cycles are equal, more prominent than the rest in the calice, their inner ends sometimes uniting in the center.

*Measurements.*—The specimen measures: Height, 6.5 mm; diameters, 9.25 by 10.5 mm; depth of calice, 3.25 mm.

*Specimen.*—U.S.N.M. no. 44288.

*Occurrence.*—In the Yellow limestone on the bridle trail near Whitney Valley,  $1\frac{1}{8}$  miles from Peace River, Clarendon Parish, Jamaica (Matley collection).

*Remarks.*—The preceding is a description of a small coral occurring with *Eupsammia clarendonensis* in the Peace River district and of which there is one specimen in the Matley collection. It probably represents a new species, but owing to the lack of other and more satisfactory specimens, it is not now named. It is distinguished from the other species of this genus occurring in the Eocene of the West Indian region by its relatively broad, low shape and deep calice; most of the species of the genus are taller, more cylindrical forms, except *A. cyclolites* (Duncan) of the upper Eocene of St. Bartholomew, which is much broader and flatter. *A. antillarum* (Duncan) approaches the Jamaican form but has a more compressed corallum.

#### Genus TROCHOSERIS Milne Edwards and Haime, 1849

##### TROCHOSERIS (?) species

*Description.*—Corallum simple, apparently free, with a broad, sub-cylindrical, slightly convex base, becoming compressed and elliptical in outline but not flaring outward near the calice. Wall apparently solid. Costae not preserved in the specimen. Calice superficial, with a long, narrow, shallow fossette. Septa, about 200 in number, strongly exsert, imperforate, unequal, laterally granulate, upper margins not preserved. The first four cycles are equal, much thicker than the rest, and extending to the center. Those of the fifth cycle also extend to the center. The remaining septa are thin and extend one-third to two-thirds of the distance to the columella. Columella thin, lamellate, spongy, papillate on top, not prominent in the fossette. Synapticae well developed, abundant. Endothecal dissepiments developed in the vicinity of the wall.

*Measurements.*—The specimen measures: Height, 34 mm; basal diameters, 40 by 45 mm; calicular diameters, 30 by 59 mm.

*Specimen*.—U.S.N.M. no. 44289.

*Occurrence*.—Probably from the Yellow limestone at Williamsfield, St. James Parish, Jamaica (Matley collection).

*Remarks*.—This specimen very likely represents a new species but it is in very poor condition as a result of much surface wear, which has almost destroyed the wall and has obliterated the upper margins of the septa. The generic affinities are doubtful until better specimens can be found.

## Family EUPSAMMIDAE Milne Edwards and Haime

### Genus EUPSAMMIA Milne Edwards and Haime, 1848

#### EUPSAMMIA CLARENDONENSIS, new species

#### PLATE 4, FIGURES 6, 7; PLATE 5, FIGURE 6

*Description*.—Corallum simple, free, small, short, turbinate or subhemispherical, with a shallow, slightly elliptical calice and a nipple-shaped scar of early attachment at the base. The exterior is not well shown by either of the specimens, but no epitheca appears to have been present. The wall is porous, synapticulatate, and of some thickness. The septa are imperforate and laminar, with a few scattered pores. Their arrangement is characteristic of the Eupsammids, the septa of the first two cycles being free and straight, extending to the center; the septa of the fourth cycle fusing to the third cycle near the columella, producing a delta-shaped group of septa; and the fifth cycle fusing to the fourth. About three-fourths of the sixth cycle is developed. The columella is well developed, spongy, and joined to the inner ends of the first three cycles of septa. The distal ends of the septa are lost in the synapticular tangle of the wall. The synapticulæ are well developed and are most abundant near the wall. There are no dissepiments.

*Measurements*.—As follows:

Specimen	Height	Diameters
	<i>Mm</i>	<i>Mm</i>
1 (type).....	6.5	10.5 by 12
2 (paratype).....	6.5	9 by 10

*Type*.—U.S.N.M. no. 44290.

*Paratype*.—U.S.N.M. no. 44291.

*Occurrence*.—In the Yellow limestone on Peace River, Clarendon Parish (type specimen); and on the bridle trail near Whitney Valley,  $1\frac{1}{8}$  miles from Peace River, Clarendon Parish (Matley collection).

*Remarks.*—This species is readily distinguished by the low sub-hemispherical corallum with a small point of early attachment and by the septal arrangement. The only American species to which it might be related is *E. conradi* Vaughan (1900b, p. 183) from the upper Eocene of Virginia and Mississippi, which has a much thicker wall and four cycles of septa.

### Family ACROPORIDAE Verrill

#### Genus DENDRACIS Milne Edwards and Haime, 1849

##### DENDRACIS CANTABRIGIENSIS Vaughan

*Dendracis cantabrigiensis* VAUGHAN, 1899, p. 248, pl. 41, figs. 3, 5, 6 (*non* 4); 1919, p. 194.—FELIX, 1925, p. 268.

*Occurrence.*—Specimen 1 is from the Yellow limestone at Spring Mount; specimens 2 and 3 are from the same formation in the Cambridge district, Jamaica (Trechmann collection).

*Remarks.*—Two small fragments and a small block containing several fragments, all from the Trechmann collection, have been identified by Dr. Vaughan with his species. There are no notable departures from his published description.

*Measurements.*—As follows:

Specimen	Length	Diameter	Diameter of calices
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	24	4	1.0
2.....	30	5	1.3
3.....	37	4 by 6	1.0

#### Genus ACTINACIS d'Orbigny, 1849

##### ACTINACIS SAWKINSI, new species

PLATE 4, FIGURE 5; PLATE 5, FIGURE 7

*Description.*—Corallum massive, upper surface convex, marked by low rounded gibbosities, under surface irregularly concave, the whole being composed of superimposed laminar layers. Corallites small, 1.2 to 1.5 mm in diameter, separated by less than their own diameter of coenenchyme. The coenenchyme is composed of perforate septo-costae, which are united by synapticulae to form a porous reticulum. Corallite walls distinct, very porous, formed by a single ring of large synapticulae connecting the thickened outer trabecular elements of the septa. The septa are straight, well developed, less in thickness than the interseptal loculi; they are al-

ways 24 in number, forming three complete cycles. The septa of the first cycle are free, extending nearly to columella, two larger ones lying in the same plane and dividing the corallite. The inner ends of the third cycle fuse near or at the inner ends of the second cycle, which is equal in length to the first. The full number of pali is 12, arranged in two crowns, but several of them may be missing. The interseptal loculi are open. The columella is styliform, well developed, often slightly compressed in the same plane as that of the two directive septa.

*Measurements.*—As follows:

Specimen	Length	Width	Maximum height
1 (type).....	<i>Mm</i> 114.5	<i>Mm</i> 45	<i>Mm</i> 44
2 (paratype).....	76	68	39

*Type.*—U.S.N.M. no. 44294.

*Occurrence.*—Both specimens are from the *Velates schmiedeliana* bed of the Yellow limestone at Spring Mount, Jamaica (Trechmann collection).

*Remarks.*—This species may be distinguished from *A. alabamiensis* (Vaughan) (1900b, p. 194; 1919, p. 486) (middle Oligocene), to which it is probably related, by the presence of three complete cycles of septa and styliform columella, *A. alabamiensis* having but 20 septa and a columella composed of septal processes.

#### ACTINACIS BARRETTI, new species

#### PLATE 4, FIGURES 1, 2

*Description.*—Corallum branching, basal portion unknown, the branches compressed and blunt. The average thickness is 6 mm, and the width varies from 7 to 8 mm. The type represents a branch that bifurcates 32 mm from the lower extremity, and each of the branches thus produced again divides. The corallites are small, not more than 1 mm in diameter, slightly projecting, and separated by less than their own diameter of coenenchyme. The coenenchyme is perforate, synapticalae uniting the perforate septo-costae to form a porous reticulum. Corallite walls very little developed, a few synapticalae forming a peripheral ring by uniting the swollen outer ends of the septa. Between the wall and the surrounding coenenchyme is an interspace traversed by nothing except a very few trabecular expansions uniting the septa and septo-costae. The full number of septa is 24, arranged in three complete cycles as in *A.*



*sawkinsi*, except that 4 to 8 of them may be lacking in some calices. They are short, tapering rapidly from a considerable thickness at the wall to a fine inner edge. Those of the first cycle are equal and free and end in a crown of pali around the columella. The second cycle is joined near the inner ends by the third cycle and terminates in a second crown of pali just outside the first. The columella is a small columnar style in the center of the corallite.

*Type*.—U.S.N.M. no. 44295.

*Occurrence*.—In the Yellow limestone in the Cambridge district, Jamaica (Trechmann collection).

*Remarks*.—This species is distinguished from *A. sawkinsi*, with which it occurs, by its smaller corallites, by the narrow space around the corallites, and by the subnormal number of septa in many of the corallites. Its branching rather than massive growth-form is also a distinction.

#### Genus *ASTREOPORA* Blainville, 1830

##### *ASTREOPORA* WALLI, new species

##### PLATE 4, FIGURE 13

*Description*.—Corallum forming branches, which may be more or less palmate in form. Palmate portions about 10 mm thick. The basal part of one branch measures about 11 by 21 mm. The calices are not preserved in the specimens. The corallites are cylindrical or slightly compressed, averaging 1 mm in diameter, spaced about 0.3 mm apart. The septa are usually 6 in number, but a few rudimentary ones may also be developed. They are short, rarely extending more than halfway to the center of the corallite. At the periphery they are expanded to form the corallite wall, which is irregularly perforate. Septo-costae are present, corresponding to the septa, but not much developed and nonconfluent. There is no columella. Uniting the corallites are numerous irregular perforate tabulae forming a loose coenenchyme.

*Type*.—U.S.N.M. no. 44296.

*Occurrence*.—In the Yellow limestone in the Cambridge district, Jamaica (Trechmann collection).

*Remarks*.—This is the first species of *Astreopora* to be described from the Eocene of the West Indian region, although several have been noted from the Oligocene by Vaughan. It is distinguished from these later species by the smaller size of the corallites, lighter coenenchyme, and lack of a columella.

## Family PORITIDAE Dana

Genus GONIARAEA d'Orbigny, 1849

GONIARAEA CHRISTIANIAENSIS, new species

## PLATE 4, FIGURE 11

*Description.*—The type is a small distal fragment of a branch measuring 17.5 mm in length and 4 mm in diameter. The calices are diamond shaped, shallow, looking upward toward the tip of the branch, and measuring 4 mm on the long diameter parallel to the axis of the branch and 2.75 mm on the shorter. The walls are thin, with acute upper edges. The septa number 12, all reaching to the columella. The columella is small, styliform, and much thickened below the calice. No pali can be discerned. The structure of the septa is obscure, but a section across one end of the branch shows them to be perforate.

*Type.*—U.S.N.M. no. 44297.

*Occurrence.*—In the Yellow limestone of the Christiania district, Manchester, Jamaica (Matley collection).

*Remarks.*—This species is very close to *G. clinactina* (Michelotti) of the middle Oligocene of Monte Grumi, specimens of which are in the National Museum, the only observable difference being in the slightly larger calices of the Jamaican form.

The single poorly preserved specimen upon which the species is based does not show the characters of the form so well as could be desired. The normal shape of the calices, that is, of the calices on the thicker main branches of the corallum, is probably not diamond shaped, but hexagonal or pentagonal, if we may judge from *G. clinactina*.

CORALS FROM THE TRECHMANN AND ROMANES COLLECTIONS  
FROM THE SCOTLAND BEDS OF BARBADOS

Seven specimens of corals were collected by Dr. C. T. Trechmann from a fossiliferous conglomerate band (evidently Bed "b" of Trechmann's 1925 paper) in the Scotland beds of the Island of Barbados, British West Indies. These were submitted to Dr. T. W. Vaughan for determination and by him turned over to the author for description. The material from the Romanes collection consists of four specimens—three of *Madracis decactis* (Lyman) and one of *Trochocyathus* sp. All the specimens are fragmentary, and, while at least two new species are represented and possibly a third, none has been described as such.

The Scotland beds have been the subject of a paper by Dr. Trechmann (1925) in which he has tentatively established them as being

of middle or upper Eocene age. A still more recent paper by Dr. Matley (1932) considers the question of the age of these beds, and, after a summary of the evidence offered by various authorities, gives them an upper Eocene age. He lists the following preliminary determination of the corals by Dr. Vaughan:

*Asterosmilia* cf. *hilli* Vaughan.

*Stephanocoenia* (?) sp.

*Madracis* (?) sp.

*Pavona* sp.

(The *Stephanocoenia* ? sp. is discussed in the present notes as *Madracis decactis*.) He mentions also that R. B. Newton determined the coral genera *Paracyathus* and *Astrocoenia* in the Romanes collection. (In the present notes the *Paracyathus* is considered as *Trochocyathus* and the *Astrocoenia* as *Madracis decactis*.)

Though it is not the purpose here to enter any controversy regarding the age of the Scotland beds, the evidence given by these small collections of corals indicates an age younger than Eocene, perhaps early Miocene.

#### Genus MADRACIS Milne Edwards and Haime, 1849

##### MADRACIS DECACTIS (Lyman)

##### PLATE 4, FIGURE 16

*Astraea decactis* LYMAN, 1859, p. 260.

*Madracis decactis* VERRILL, 1864, p. 45.—GREGORY, 1895, p. 258, fig. 1.

*Specimens*.—U.S.N.M. no. 44301; Brit. Mus. (N.H.) nos. R29689, R29690, R29691.

*Occurrence*.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann and Romanes collections).

*Remarks*.—Seven specimens are referred to this species. The calicular surface is not preserved in any specimen, but the internal structure corresponds exactly to that of specimens from the Miocene of the Dominican Republic in the National Museum. The corallites average 1.5 mm in diameter and are closely packed together. There are 10 well-developed septa that reach the columella and 10 rudimentary septa that appear on the interior of the corallites as spines projecting into the corallite cavity. The dissepiments are well developed and horizontal. The specimens represent fragments from larger coralla.

*M. decactis* ranges from Miocene<sup>4</sup> to Recent.

<sup>4</sup> Vaughan and Woodring, 1921, pp. 99, 133, 152, 157 (Miocene); p. 167 (Pleistocene).

## MADRACIS (?) species

## PLATE 4, FIGURES 14, 15

*Description.*—A fragmentary specimen is doubtfully placed in this genus. The branch is about 6.5 mm in diameter and is marked by what appears to be an axial corallite, a feature not present in *Madracis*. The calices are shallow, widely separated, and not projecting, except the axial corallites, which occupy the tops of conical protrusions indicating the formation of a new branch. Their diameter varies from 1.8 mm to 2 mm. There are 10 well-developed septa, which join the broad styliform columella. Between them are 10 very rudimentary septa. The surface of the coenenchyme between the corallites is not costulate but finely striate and granulate. The coenenchyme is very dense to a depth of 0.75 mm, the interior of the branch being cellular or open in the region of the axial corallite.

*Specimen.*—U.S.N.M. no. 44302.

*Occurrence.*—In a conglomerate band in the Scotland beds in the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).

*Remarks.*—It is unfortunate that the single specimen of this interesting form is not more complete, because the apparent presence of an axial corallite separates it from the genera of the Seriatoporidae, the rest of the characters linking it to *Madracis*. If the axial corallite is really present it would indicate a new genus bearing approximately the same relation to *Madracis* as *Archohelia* does to *Oculina*.

Trenchmann's *Stylocoenia* (?) sp. (1925, pl. 24, fig. 47) appears to be a *Madracis*, but his figure is not clear enough to identify the species.

## Genus TROCHOCYATHUS Milne Edwards and Haime, 1848

## TROCHOCYATHUS (?) species

*Specimen.*—Brit. Mus. (N.H.) no. R29688.

*Occurrence.*—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Romanes collection).

*Remarks.*—One specimen, placed doubtfully in this genus, is a portion of a conical corallum of a caryophyllid coral that has lost both calice and base. The exterior is worn away. The septa number 40 and appear to alternate regularly in size. The longer ones bear pali, which form two crowns around the columella. The columella is well developed and fascicular.

It is not unlikely that this is a species of *Paracyathus*, but the lack of a basal portion of the specimen prevents the settling of this point. *Paracyathus henekeni* Duncan (1863, p. 426) of the lower Miocene of San Domingo is a much smaller species.

## Genus ASTEROSMILIA Duncan, 1867

ASTEROSMILIA species cf. A. HILLI Vaughan, 1919

*Specimen*.—U.S.N.M. no. 44303.

*Occurrence*.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).

*Remarks*.—One specimen is placed in affinity with this species. The only differences between it and typical specimens from the Dominican Republic are that the wall is somewhat thicker and the costae more regularly alternating in size in the Barbados specimen.

*A. hilli* Vaughan (1919, p. 355) occurs in the Miocene of Costa Rica, Jamaica, and the Dominican Republic.

## Genus PAVONA Lamarck, 1801

PAVONA species

PLATE 4, FIGURE 17

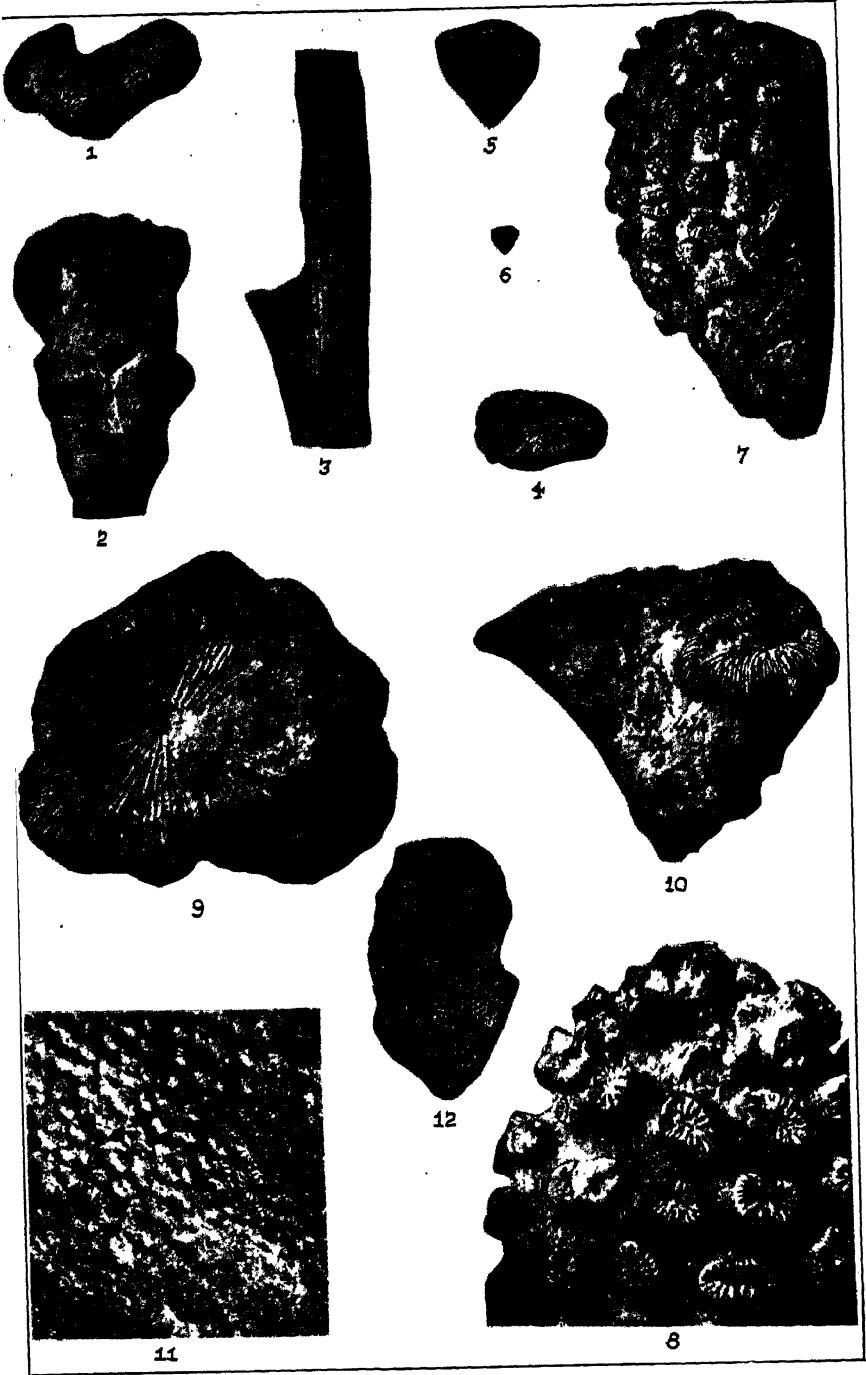
*Description*.—The specimen is a single much-worn fragment of a unifacial frond, measuring 20 by 25 by 12 mm. The noncalicular surface bears alternating costae numbering 8 to 10 in a space of 2 mm. The worn calicular surface bears scattered calices, which range from 1.5 to 2 mm in diameter, separated by a distance of 3.5 to 4 mm between centers, united by regularly alternating septo-costae. The centers are circumscribed by a ring of strongly developed synapticulae separating them from the intercorallite areas. Within the calices there are from 20 to 24 septa, about 10 of which extend to the columella. The columella is trabecular, formed by the fused inner ends of the longer septa.

*Specimen*.—U.S.N.M. no. 44304.

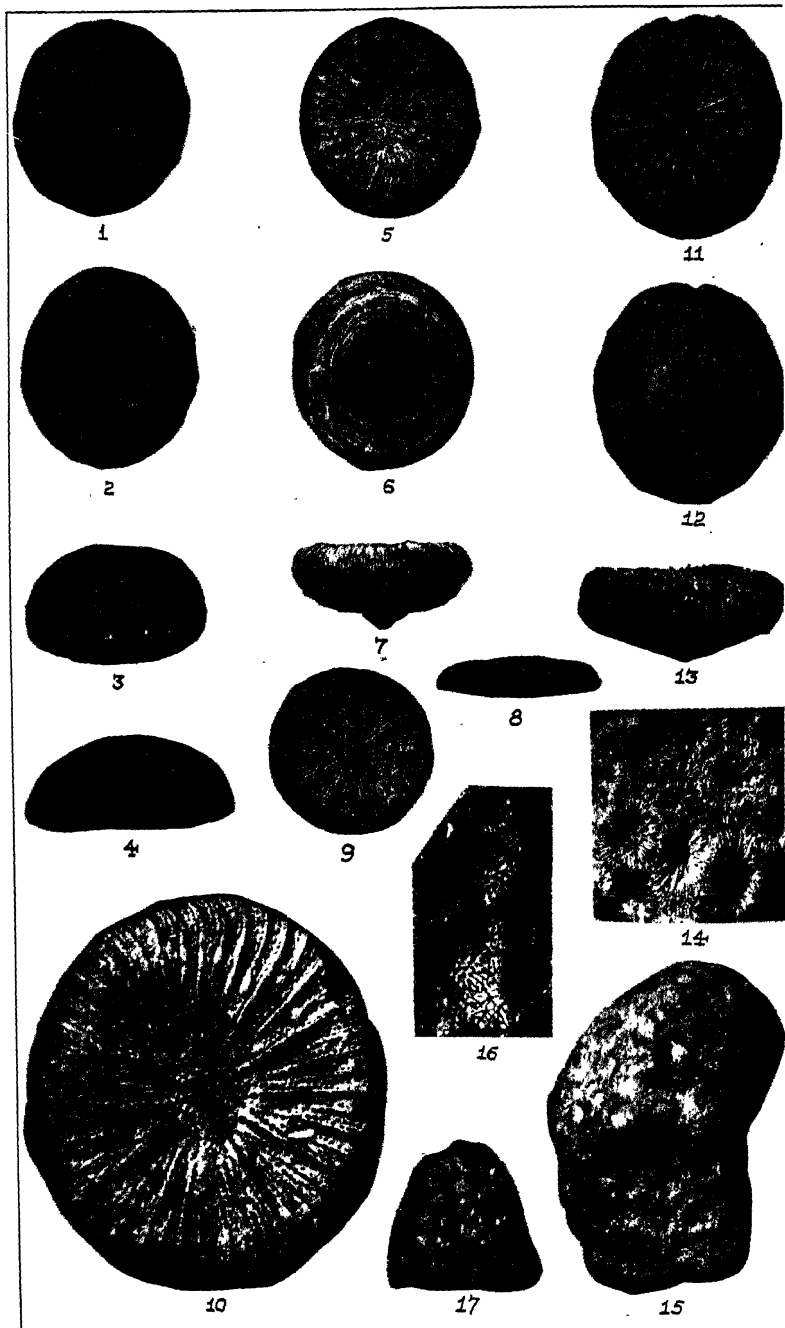
*Occurrence*.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).

*Remarks*.—This specimen probably represents a new species of *Pavona*, but the material is too scanty for further treatment. *P. panamensis* Vaughan, from the upper Oligocene of the Canal Zone, differs by having larger calices in definite series with subequal, larger septo-costae. *P. pennyi* Vaughan, from the Miocene of Trinidad, has larger calices with fewer main septa and a larger total number of septa as well as a compressed styliform columella.

*Pavona* occurs in the upper Oligocene and Miocene of the Caribbean region and is living in the Indo-Pacific.

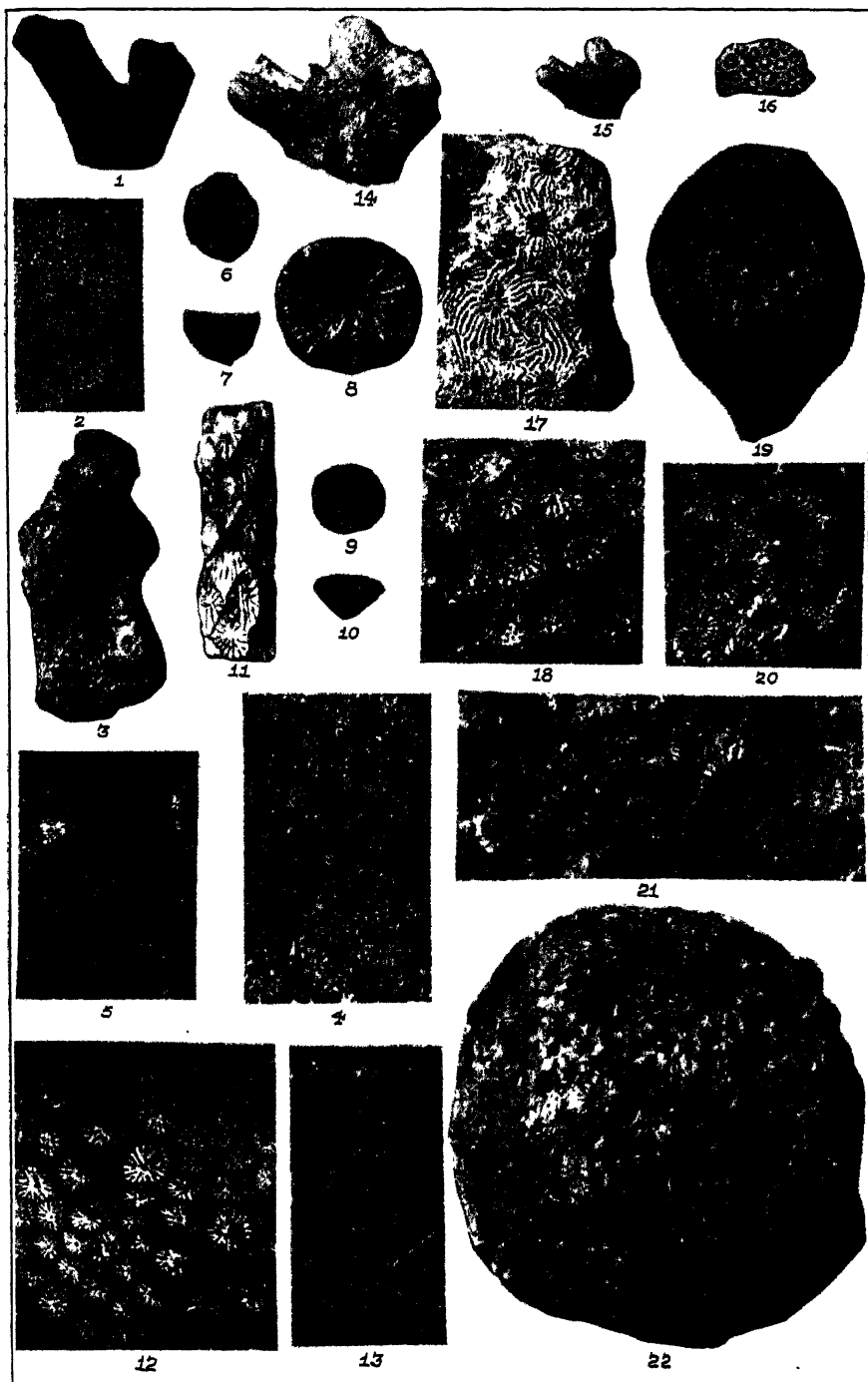


WEST INDIAN FOSSIL CORALS.  
FOR EXPLANATION OF PLATE SEE PAGE 109.



WEST INDIAN FOSSIL CORALS.

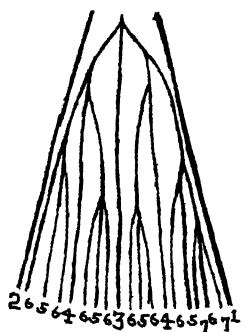
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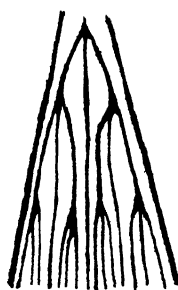
WEST INDIAN FOSSIL CORALS.

FOR EXPLANATION OF PLATE SEE PAGE 110.





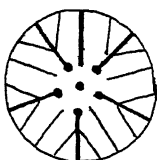
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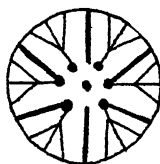
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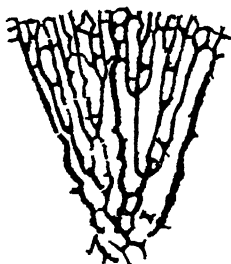
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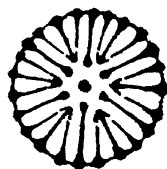
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7

WEST INDIAN FOSSIL CORALS.

FOR EXPLANATION OF PLATE SEE PAGE 110.

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## EXPLANATION OF PLATES

### PLATE 2

- FIGURES 1, 2. *Diplaraea* (?) *boltonae*, new species: 1, Calicular surface of type; 2, lateral view of type.  $\times 1$ .  
 3, 4. *Rhabdophyllia quaylei*, new species: 3, Lateral view of paratype; 4, calice of type.  $\times 1$ .  
 5, 6. *Trochocyathus maileyi*, new species: 5, Lateral view of type,  $\times 4$ ; 6, lateral view of type,  $\times 1$ .  
 7, 8. *Dichocoenia trechmanni*, new species: 7, Corallum of type,  $\times 1$ ; 8, calices of type,  $\times 2$ .  
 9, 10. *Trochoseris catadupensis* Vaughan: 9, Calice of large specimen; 10, lateral view of same.  $\times 1$ .  
 11, 12. *Centrastrea hilli*, new species: 11, Calicular surface of holotype,  $\times 4$ ; 12, calicular surface of holotype,  $\times 1$ .

### PLATE 3

- 1-4. *Oyclolites jamaicaensis*, new species: 1, Calicular view of type; 2, basal view of type; 3, lateral view of type; 4, lateral view of paratype.  $\times 1$ .  
 5-10. *Paracycloseris elizabethae*, new genus and species: 5, Calicular view of type,  $\times 1$ ; 6, basal view of type,  $\times 1$ ; 7, lateral view of type,  $\times 1$ ; 8, lateral view of paratype,  $\times 1$ ; 9, calicular view of paratype,  $\times 1$ ; 10, calicular view of type,  $\times 2$ .  
 11-13. *Vaughanoseris catadupensis*, new genus and species: 11, Calicular view of type; 12, basal view of type; 13, lateral view of type.  $\times 1$ .  
 14, 15. *Synastrea* (?) *adkinsi*, new species: 14, Calices of holotype,  $\times 2$ ; 15, corallum of holotype,  $\times 1$ .  
 16, 17. *Goniopora trechmanni*, new species: 16, Calicular surface of paratype,  $\times 4$ ; 17, corallum of paratype,  $\times 1$ .

## PLATE 4

*Eocene*

- 1, 2. *Actinacis barretti*, new species: 1, Corallum of type,  $\times 1$ ; 2, transverse section of corallites of type,  $\times 4$ .
- 3, 4. *Stylophora cambridgensis*, new species: 3, Corallum of type,  $\times 1$ ; 4, calices of type,  $\times 4$ .
5. *Actinacis sawkinsi*, new species: Transverse section of corallites of type.  $\times 4$ .
- 6, 7. *Eupsammia clarendonensis*, new species: 6, Calicular view of type; 7, lateral view of type.  $\times 1$ .
- 8-10. *Antilloseris* (?) sp.: 8, Calicular view,  $\times 2$ ; 9, calicular view,  $\times 1$ ; 10, lateral view,  $\times 1$ .
11. *Goniaraea christianaensis*, new species: Holotype.  $\times 2$ .
12. *Astrocoenia jamaicaensis*, new species: Calices of type.  $\times 2$ .
13. *Astreopora walli*, new species: Transverse section of corallites.  $\times 4$ .

*Tertiary*

- 14, 15. *Madracis* (?) sp.: 14, Fragment of corallum,  $\times 2$ ; 15, fragment of corallum,  $\times 1$ .
16. *Madracis decactis* (Lyman): Worn fragment of corallum.  $\times 1$ .
17. *Pavona* sp.: Worn calicular surface.  $\times 2$ .

*Cretaceous*

18. *Goniopora reussiana* (Duncan): Calices.  $\times 4$ .
- 19, 20. *Favioseris anomalos*, new genus and species: 19, Corallum of holotype,  $\times 1$ ; 20, calices of holotype,  $\times 2$ .
- 21, 22. *Prodiploastrea schindewolfi*, new genus and species: 21, Calices of holotype,  $\times 2$ ; 22, corallum of holotype,  $\times 1$ .

## PLATE 5

1. *Paracycloseris elizabethae*, new genus and species: Diagram of septal arrangement.  $\times 4$ .
2. *Fungia* (*Cycloseris*) *patella* (Ellis and Solander): Diagram of septal arrangement (seventh cycle not shown).  $\times 3$ .
3. *Vaughanoseris catadupensis*, new genus and species: Transverse section.  $\times 3$ .
4. *Goniopora reussiana* (Duncan): Diagram of septal formula.
5. Typical *Goniopora*: Diagram of septal formula. (After Bernard, 1903.)
6. *Eupsammia clarendonensis*, new species: Transverse section of paratype showing septal arrangement.  $\times 8$ .
7. *Actinacis sawkinsi*, new species: Diagram of septal and paler arrangement.  $\times 15$ .

# PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM



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## FOSSIL HARES FROM THE LATE PLIOCENE OF SOUTHERN IDAHO

By C. LEWIS GAZIN

*Assistant Curator, Division of Vertebrate Paleontology, United States National  
Museum*

AMONG the fossil remains of late Pliocene mammals from lake deposits near Hagerman in southern Idaho are a number of specimens representing leporid types. Three distinct species are recognized, two of which are referred to the genus *Hypolagus*. The third may represent *Alilepus*, a lagomorph previously known from the Neocene of Asia. Comprising the material are a well-preserved skull with the atlas and right ramus of the mandible associated, four fragmentary jaws, an assortment of isolated teeth, and a few limb bones. The greater part of the National Museum material was collected by Elmer Cook, of Hagerman, from various localities south of the *Plesippus shoshonensis* quarry. A few specimens, however, including the *Alilepus*? jaw, were encountered in the quarry during operations there by Smithsonian Institution parties.

A third species of *Hypolagus* is represented in collections made by an expedition from the California Institute of Technology at a locality near Grand View in southwestern Idaho. The fauna from Grand View is not identical with that from Hagerman, and although the difference may be attributed to the geographic separation of the localities, it seems likely that the two are of slightly different age. Presumably, the Grand View occurrence is of later date. The Grand View lagomorph material was loaned to me for study through the kindness of Dr. Chester Stock.

Upper Pliocene lagomorphs are relatively little known, and heretofore the occurrence of these forms in the Idaho beds has not been recorded. The number of species here recognized is noteworthy, a diversity approaching that of the rabbits and hares now living in southern Idaho. The recent fauna in the vicinity of Hagerman includes the white-tailed and black-tailed jack rabbits (*Lepus townsendii townsendii* and *L. californicus deserticola*), the sage cottontail (*Sylvilagus nuttalli grangeri*), and the pigmy rabbit (*Brachylagus idahoensis*). To the north, in the mountainous portion of the State, are found the snow-shoe rabbit (*Lepus bairdii bairdii*) and the pika (*Ochotona princeps lemhi*). A second pika (*Ochotona schisticeps goldmani*) is recorded from the lava beds to the northeast of Hager-

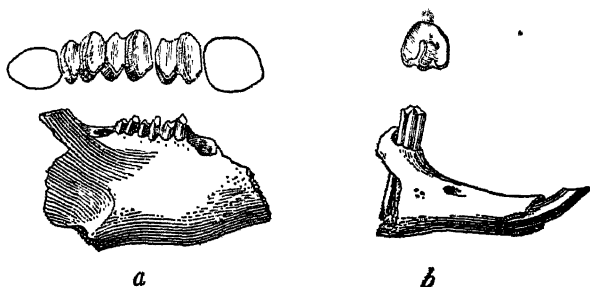


FIGURE 1.—*Hypolagus*, near *vetus* (Kellogg): a, Fragment of right ramus of mandible (U.S.N.M. no. 12620); b, fragment of right ramus of mandible (U.S.N.M. no. 12621). Lateral views  $\times 1$ , occlusal views  $\times 2$ . Hagerman lake beds, Upper Pliocene, Idaho.

man. A marked diversity of lagomorphs is also found to the south in the Basin and Range province.

Drawings for all the figures herein were made by Sydney Prentice.

#### HYPOLAGUS, near VETUS (Kellogg)<sup>1</sup>

##### FIGURE 1

Three fragmentary mandibles, a number of isolated teeth, and a few limb bones from the vicinity of Hagerman, Idaho, are recognized as belonging to a species near, or possibly identical with, *Hypolagus vetus*. *H. vetus* is the type species and was originally described from the Pliocene beds at Thousand Creek in northwestern Nevada. It appears likely that the Hagerman material is specifically distinct from the form occurring in the earlier Pliocene beds of Nevada, but the few differences observed in the incomplete material at hand do not warrant recognizing a distinct form.

<sup>1</sup> Kellogg, L., Univ. California Publ. Bull. Dept. Geol., vol. 5, pp. 436-437, 1910; see also Dice, L. R., Univ. California Publ. Bull. Dept. Geol., vol. 10, pp. 181-182, 1917.

Comparison between the Hagerman specimens and topotype material of *H. vetus* in the collections of the California Institute of Technology shows the Idaho form to be very nearly the same size as *H. vetus*, comparable in this respect with specimens of *Lepus townsendii*. Two of the jaw portions appear to be somewhat more robust than in *H. vetus* and in U.S.N.M. no. 12620 (fig. 1a); the lower tooth row is slightly longer and the individual teeth relatively a little wider. Moreover, several of the third lower premolars, though similar in pattern to those of *H. vetus*, are a little larger and somewhat more rounded antero-internally, giving the anterior portion of the tooth a relatively greater width. Two isolated P<sup>2</sup> from near Hagerman show a deep anterior reentrant enamel fold directed postero-externally and a much shallower groove external to this, much as in *H. vetus*. The upper molariform teeth are similar to those in the Nevada specimens.

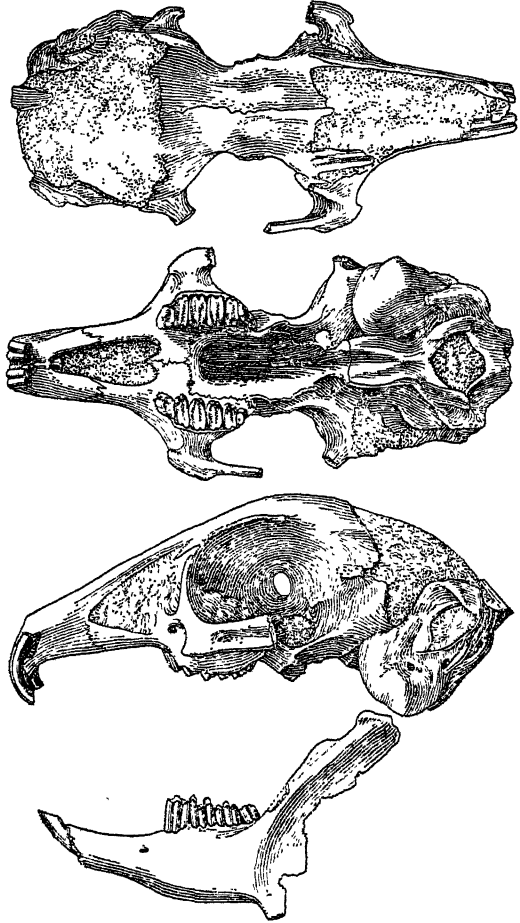


FIGURE 2.—*Hypolagus limnetus*, new species: Skull and mandible, type specimen (U.S.N.M. no. 12619); dorsal, ventral, and lateral views of skull and lateral view of right ramus (reversed) of mandible;  $\times 1$ . Hagerman lake beds, Upper Pliocene, Idaho.

The Hagerman form appears somewhat more advanced than the Thousand Creek *Hypolagus vetus*, as suggested by the slightly greater relative width of the lower teeth in one of the jaws and perhaps by the greater average robustness of the jaws of the Idaho form. In all probability a single line of descent is represented, the Middle Pliocene form in Nevada giving rise to the larger of the late Plio-



cene types occurring at Hagerman. As to whether this line led to any of the large species of *Lepus* there is no certainty. As yet no types have been described from the Pliocene or Pleistocene of North America clearly bridging the seemingly trivial, yet apparently persistent, dental characters cited by Dice as distinguishing *Hypolagus* from *Lepus* and *Sylvilagus*. Moreover, it is interesting to note that fossil materials recognized as including both *Hypolagus* and *Lepus* have been found in an early Pleistocene occurrence at Anita, Ariz.<sup>2</sup>

**HYPOLAGUS LIMNETUS, new species**

**FIGURES 2, 3**

*Type*.—Skull, right ramus of mandible, and atlas, U.S.N.M. no. 12619.

*Locality*.—T. 7 S., R. 13 E., about 2 miles south of the *Plesippus* quarry, near Hagerman, Idaho.

*Horizon*.—Hagerman lake beds.

*Specific characters*.—Size near that of *Sylvilagus nuttalli grangeri*, much smaller than *Hypolagus vetus*. Rostrum relatively short and cranial portion elongate. Cranium shallower posteriorly and less depressed with respect to the rostrum than in *S. nuttalli grangeri*. Posterior nasal opening dorsoventrally deep and transversely constricted. Bullae very large. Basi-occipital narrow and elongate. Teeth about equal in size to those of *S. nuttalli grangeri*. Anterior upper incisors strongly recurved with anterior groove more nearly median in position. P<sup>2</sup> with two unequal reentrant folds and P<sub>3</sub> with anterior external reentrant fold relatively deep.

*Material*.—The skull (fig. 2) belonging to the type is remarkably well preserved and includes the entire dentition. However, the specimen lacks the nasals, parietals, the left and part of the right zygoma, and the right bulla. The atlas and greater portion of the right ramus of the mandible were found in position with the skull, the ramus incomplete only in the region of the angle. In addition to the type a few isolated teeth and some fragments of limb bones are recognized as belonging to this species.

*Description*.—In size *Hypolagus limnetus* is only slightly smaller than the sage cottontail (*Sylvilagus nuttalli grangeri*) now living on the Snake River Plains, although considerably larger than the pigmy rabbit (*Brachylagus idahoensis*). Compared with the sage cottontail the fossil skull has a relatively shorter rostrum and an anteroposteriorly longer basicranial region. The cranial portion of the skull is not so depressed posteriorly, and the supra-occipital is dis-

<sup>2</sup> Hay, O. P., Proc. U. S. Nat. Mus., vol. 59, pp. 628-631, 1921; see also Dice, L. R., Papers Michigan Acad. Sci., Arts, and Letters, vol. 16, pp. 379-382, figs. 8-11, 1932.

tinctly shorter dorsoventrally. The tympanic bulla is of considerable size, much larger than in *S. nuttalli grangeri* and nearly as large relatively as in *B. idahoensis*. The space between the bullae is less than in the cottontail and the basi-occipital is about one-fourth longer. The ectopterygoid fossae are about the same distance posterior to the cheek teeth as in *S. nuttalli grangeri* but much farther forward from the foramen magnum, apparently because of the greater inflation of the bullae. The posterior nasal opening is relatively deep and distinctly narrower transversely than in *Sylvilagus*, much as in *Romerolagus*. The palatines form a more distinct ledge or ridge inward from the posterior molars on each side than in *Sylvilagus*. The palatines on either side of the nasal opening are nearly parallel in the fossil, whereas in *Sylvilagus* the widest portion of the opening is to the front, converging posteriorly. The bony palate between the grinding teeth is short as in *Sylvilagus*, the palatal processes of the palatines being more reduced than in *Romerolagus*. Only a part of the right jugal is preserved in the fossil, but this portion is a little deeper than in *S. nuttalli grangeri*, and anteriorly the outward flare of the ventral surface is less pronounced. The postorbital processes are broken away, but on both sides the length of the break is short, suggesting that the process consisted only of a backward-projecting spur.

The upper teeth in the fossil are nearly identical in size with those in *Sylvilagus nuttalli grangeri*, although the diastema between the incisors and cheek teeth is much shorter. The principal incisors are more recurved than in the cottontail, and the groove on the anterior surface is more nearly median in position. The small posterior incisors show no differences other than being directed backward to a greater degree. The enamel pattern of P<sup>2</sup> (fig. 3a) differs from that in the recent Idaho cottontail in having only two reentrant folds on the anterior surface. Both folds are relatively shallow, the more lingual fold being the deeper. In *S. nuttalli grangeri* there are three distinct anterior folds, the middle fold being deeper than the others, and in addition there is a very shallow groove near the external margin. The succeeding molariform teeth in the fossil resemble very closely those in the cottontail. The crenulated medial lingual folds in these teeth extend almost as far externally as in *S. nuttalli grangeri*.

The mandible shows about the same proportions as in *Sylvilagus nuttalli grangeri*, although the diastema between the incisor

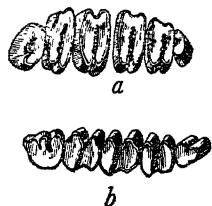


FIGURE 3. — *Hypolagus timnetus*, new species: a, Left superior dentition; b, right inferior dentition; type specimen (U.S.N.M. no. 12619); occlusal views,  $\times 2$ . Hagerman lake beds, Upper Pliocene, Idaho.

and  $P_3$  is a little shorter and the anterior surface of the ascending ramus rises more steeply, placing the condyle slightly higher and a little farther forward than in the living rabbit.

As is true in the upper dentition, the size of the lower teeth can be closely matched in specimens of *Sylvilagus nuttalli grangeri*. The lower incisor shows a longer bevel, apparently accompanied by a slightly more acute cutting edge; also the posterior surface of the incisor does not show the slight longitudinal concavity or groove commonly present in *S. nuttalli grangeri*.  $P_3$  (fig. 3b) shows the pattern typical of *Hypolagus* in which the posterior of the two external reentrant folds extends only about halfway across the tooth, there being no reentrant from the internal surface. The anterior external fold, however, appears more deeply impressed than is usual in *Hypolagus*. In *Sylvilagus* and *Lepus* the posterior external reentrant fold extends nearly or entirely to the internal surface of the tooth, and the anterior surface of the anterior column is commonly complicated by one or more shallow reentrant folds or grooves. The molariform lower cheek teeth of the fossil show no important characters distinguishing them from these teeth in the sage cottontail of Idaho.

*Comparison.*—*Hypolagus limnetus* is distinctly smaller and less robust than *Hypolagus vetus*, or the large Hagerman form close to *H. vetus*. The lower jaw is slenderer, shallower, and has teeth about one-fourth smaller. The two enamel folds on the anterior surface of  $P^2$  are much shallower at the stage of wear observed than in *H. vetus*, whereas the lingual reentrant folds on the upper molariform teeth appear somewhat more deeply impressed; also the anterior external fold on  $P_3$  appears to be deeper than in *H. vetus*.

*Hypolagus edensis* Frick,<sup>3</sup> from the Eden Pliocene beds in southern California, is apparently somewhat smaller than *H. limnetus*. The anterior external enamel fold of  $P_3$  in *H. edensis* appears rather deep, but is placed more nearly on the anterior surface of the tooth. Also, the figures of the lower molariform teeth show them to be more rounded internally than in *H. limnetus*.

*Hypolagus browni* (Hay)<sup>4</sup> from the early Pleistocene occurrence at Anita, Coconino County, Ariz., is a small species, intermediate in size between *Hypolagus limnetus* and *Brachylagus idahoensis*. The anterior portion of a skull, U.S.N.M. no. 10197, of *H. browni* shows few differences other than that of size from the skull of *H. limnetus*. The upper molariform teeth in the two species are similar, although the median fold in each of the teeth appears somewhat more crenulated in *H. limnetus*. The lower jaw of *H. browni* is distinctive in that the ascending ramus rises much less steeply than in *H.*

<sup>3</sup> Frick, Childs, Univ. California Publ. Bull. Dept. Geol., vol. 12, p. 348, figs. 52, 53, 1921.

<sup>4</sup> Hay, O. P., *op. cit.*, pp. 630, 631, 1921; also Dice L. R., *op. cit.*, 1932.

*limnetus*, and the condyle is considerably lower and somewhat more posterior in position. The first cheek tooth of *H. browni* is rather distinctive and apparently shows some variation in the enamel pattern between specimens. In three lower jaws the posterior external fold in  $P_3$  extends slightly more than halfway across the tooth and near its inner extremity shows one to three plications. A fourth specimen, that figured by Dice, shows an enamel lake near the lingual side of  $P_3$ , opposite the posterior external fold.

There is in the Anita collection a jaw portion exhibiting all cheek teeth except  $M_3$ , a specimen not examined by Hay or by Dice since the matrix has only just been removed. The jaw corresponds closely in size with those recognized as *Hypolagus browni*, but  $P_3$  is a little larger and the posterior reentrant fold extends completely across the tooth and is open internally. A short distance below the occlusal surface, however, this fold is cut off internally. Also, there is present a slight groove on the anterior surface. This specimen may represent a species of *Sylvilagus* or *Lepus*, or possibly represent an extreme variant of *H. browni* in which the teeth are perhaps at an earlier stage of wear than in other specimens.

The lepores from the Miocene are in general of a more primitive type than the Thousand Creek *Hypolagus vetus* and show a closer approximation to the conditions seen in the John Day *Archaeolagus ennisianus*. Species in this category include *Archaeolagus? macrocephalus* (Matthew)<sup>5</sup> and *Archaeolagus? primigenius* (Matthew) from the Upper Rosebud of South Dakota and *Hypolagus? apachensis* Gazin<sup>6</sup> from the Upper Miocene of southern California. Illustrations and measurements for the types from the Rosebud were given by E. R. Hall<sup>7</sup> incidental to a description of the rabbit material from the later Tertiary at Fish Valley, Nev.

*Remarks.*—The skull of *Hypolagus limnetus* is decidedly modern in appearance but has retained to a certain degree many of the primitive characters observed in *Palaeolagus*. Several of those characters in which the Hagerman form differs from modern *Sylvilagus* and *Lepus* are suggestive of conditions more conspicuous in the Oligocene rabbits. These include the shorter rostrum; less depressed cranium, which is associated with a smaller angle between the basifacial and basicranial axes; large, less widely separated bullae; anteroposteriorly elongate basioccipital; a more constricted posterior nasal passage; deeper zygomatic arches; and presumably simpler postorbital processes. The dentition of *H. limnetus* is quite removed from that in *Palaeolagus* but may well have been derived from the latter through such forms as *Archaeolagus ennisianus*.

<sup>5</sup> Matthew, W. D., Bull. Amer. Mus. Nat. Hist., vol. 23, pp. 214–216, 1907; vol. 50, pp. 86–87, 1924.

<sup>6</sup> Gazin, C. L., Carnegie Inst. Washington Publ. 404, pp. 67–69, pl. 3, figs. 1–4, 1930.

<sup>7</sup> Hall, E. R., Univ. California Publ. Bull. Dept. Geol., vol. 19, pp. 308–311, figs. 25–28, 1930.

## HYPOLAGUS FURLONGI, new species

FIGURE 4

*Type*.—Right ramus of mandible with incisor and  $P_3$  to  $M_2$  inclusive, Calif. Inst. Techn. Coll. Vert. Pal. no. 1321.

*Locality*.—Near Grand View, Idaho.

*Formation*.—Idaho formation?

*Specific characters*.—Size about equal to *Hypolagus limnetus*. Mandible of less depth and diastema between I and  $P_3$  shorter but

with upper and lower teeth approximately as large in *H. limnetus*.  $P^2$  with deep crenulated reentrant fold on anterior surface and a shallow antero-external groove.  $P_3$  triangular in outline with antero-external fold shallow.

*Material*.—The California Institute of Technology collection of lagomorph remains from near Grand View, Idaho, includes four fragmentary mandibles, no. 1321 to no. 1324, inclusive, exhibiting one to four cheek teeth each. The type, no. 1321 (fig. 4b), includes also the incisor, but in this specimen  $P_4$  and  $M_1$  are not so complete as in no. 1322. A left maxillary portion, no. 1325 (fig. 4a), referred to this species includes the entire cheek tooth series. In addition to these there are several more incomplete maxillary and jaw portions and a number of isolated teeth.

*Description*.—The Grand View lagomorph approaches closely in size the small rabbit *Hypolagus limnetus*, from Hagerman. The maxillary portion equals in size and markedly resembles that of *H. limnetus*. However the first upper cheek tooth exhibits a deeper

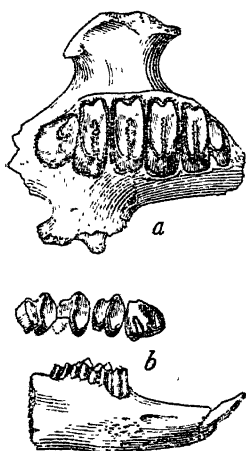


FIGURE 4.—*Hypolagus furlongi*, new species: a, Left maxilla with superior dentition (C.I.T. no. 1325), occlusal view,  $\times 2$ ; b, right ramus of mandible, type specimen (C.I.T. no. 1321), lateral view  $\times 1$ , occlusal view  $\times 2$ . Grand View, Idaho.

reentrant fold on the anterior face, which is in addition distinctly crenulated. External to this fold is a slight groove, which is somewhat shallower than in *H. limnetus*. The remaining upper cheek teeth of *Hypolagus furlongi* apparently cannot be distinguished from those in the Hagerman form.

The depth of the lower jaws of *Hypolagus furlongi* is a little less than in *H. limnetus*, and the diastema between the incisor and  $P_3$  is appreciably shorter although the cheek teeth are about as large.  $P_3$  appears distinct from that in *H. limnetus* in being markedly triangular in outline as viewed from above. The postero-internal angle of this tooth is somewhat more acute. The posterior external reen-

trant fold shows no differences, but the anterior external fold appears a little shallower. Moreover, one of the isolated  $P_3$  and this tooth in no. 1322 show a slight groove on the anterior face. No differences were observed between the species in the lower molariform teeth.

The species *Hypolagus limnetus* and *Hypolagus furlongi* are very close and the differences separating them may be only of geographic importance, but probably the deposits in which remains of the two were found are of slightly different age as indicated by the specific differences observed between the otters<sup>8</sup> and some of the rodents.<sup>9</sup> In these cases the Grand View stage appears somewhat more advanced.

**ALILEPUS? VAGUS, new species**

FIGURE 5

*Type*.—The anterior portion of a right mandibular ramus including  $P_3$ , U.S.N.M. no. 12622.

*Locality*.—T. 7 S., R. 13 E., *Plesippus* quarry, near Hagerman, Idaho.

*Horizon*.—Hagerman lake beds.

*Specific characters*.—Size near that of *Hypolagus vetus*, somewhat smaller than *Alilepus annectens* (Schlosser). Portion of jaw between I and  $P_3$  relatively short and heavy. Outward deflection of inferior margin of ramus, just anterior to lower end of  $P_3$ , somewhat sharper than in *H. vetus*. I and  $P_3$  relatively large.  $P_3$  with posterior external reentrant fold extending about halfway across tooth and internal fold reaching slightly less than halfway. Anterior external reentrant fold shallow and rounded.

*Description*.—The only specimen exhibiting the peculiar character suggesting an alliance with Schlosser's *Lepus annectens*<sup>10</sup> from the latter Tertiary of Mongolia is a single fragmentary ramus (fig. 5) with the third premolar and the basal portion of the incisor. The specimen corresponds very closely in size with the large *Hypolagus* jaws from Hagerman but shows several features indicating it to be a distinct type. The jaw portion anterior to  $P_3$  is short and moderately robust, accommodating a particularly broad incisor. The mental foramen is of good size and is placed well out on the external surface of the jaw. The inferior margin of the

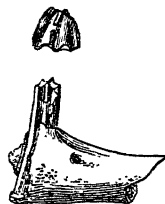


FIGURE 5.—*Alilepus? vagus*, new species: Fragment of right ramus of mandible, type specimen (U.S.N.M. no. 12622); lateral view  $\times 1$ , occlusal view  $\times 2$ . Hagerman lake beds, Upper Pliocene, Idaho.

<sup>8</sup> Gazin, C. L., Journ. Mamm., vol. 15, no. 2, pp. 137-149, 1934.

<sup>9</sup> Wilson, R. W., Carnegie Inst. Washington Publ. 440, pp. 119-135, 1933.

<sup>10</sup> Schlosser, Max, Pal. Sinica, ser. C, vol. 1, fasc. 1, pp. 45-48, figs. 37-38, 1924.

jaw and the lower part of the lingual surface turn outward just anterior to  $P_3$  somewhat more sharply than in *Hypolagus vetus*. Compared with specimens of *Lepus townsendii* having a  $P_3$  of about the same size, the anterior portion of the *Alilepus? vagus* jaw is much shorter, deeper anteriorly, and exhibits the base of a distinctly broader incisor.

Presumably, the most distinctive feature is the enamel pattern of  $P_3$ , which exhibits in addition to the two external reentrant folds seen in *Hypolagus* a deep internal fold extending nearly to the posterior external fold. The heavy enamel of the anterior portion of the internal fold forms with the anterior portion of the posterior external fold a prominent, but discontinuous, transverse ridge on the occlusal surface. The posterior external fold extends about halfway across the tooth and near its inner extremity shows a slight flexure. The anterior external reentrant fold is moderately shallow and rounded internally. The anterior column of  $P_3$  is more nearly triangular in cross section than this portion of  $P_3$  in the Hagerman *Hypolagus* material.

*Alilepus? vagus*, as indicated by the enamel pattern of  $P_3$ , appears to be related to the species *Lepus annectens* Schlosser, which Dice<sup>11</sup> has made the type of *Alilepus*, from the Upper Miocene or Pliocene of northern China and Mongolia. The Idaho form is somewhat smaller, judged by the measurements given by Schlosser and by Young,<sup>12</sup> and the antero-external angle of  $P^3$  is sharper and more outstanding. In the figure given by Young for the specimen from northern China the external reentrant folds in  $P_3$  appear much less deeply impressed than in the Idaho specimen.

The small rabbit *Romerolagus diazi*, now living on some high mountain peaks in Mexico, exhibits an internal reentrant fold on  $P_3$ . In this type the internal fold is much constricted or closed at the lingual surface of the tooth, and the posterior portion of the fold is finely crenulated, as are the anterior surfaces of the posterior columns of  $P_4$  to  $M_2$ , inclusive.

It is possible that *Alilepus? vagus* was derived from the Asiatic group. A wide distribution for this genus would not be unexpected considering the presence in the living fauna of North America of the unique *Romerolagus*, the relations of which may be closer to such forms as *Alilepus* than to *Lepus* and *Sylvilagus*. However, whether phylogenetic speculations are warranted by the implications of the pattern of  $P_3$  remains to be demonstrated.

<sup>11</sup> Dice, L. R., Journ. Mamm., vol. 12, no. 2, p. 159, 1931.

<sup>12</sup> Young, C. C., Pal. Sinica, ser. C, vol. 5, fasc. 3, pp. 62-63, pl. 3, figs. 12, 13, 1927.

TABLE 1.—Measurements (in millimeters) of skull and superior dentition

Measurement	<i>Hypolagus limnetus</i>	<i>Hypolagus furlongi</i>
	U.S.N.M. no. 12619 (type)	C.I.T. no. 1325
Length of skull from anterior surface of incisors to supra-occipital.....	<sup>1</sup> 67.0	-----
Length of skull from anterior surface of incisors to inferior margin of foramen magnum.....	55.7	-----
Distance from anterior surface of incisors to bony palate.....	21.0	-----
Length of anterior palatine foramina.....	15.5	-----
Greatest width across anterior palatine foramina.....	6.3	-----
Least anteroposterior length of bony palate.....	5.5	-----
Distance from posterior margin of bony palate to posterior margin of basisphenoid.....	20.4	-----
Width of posterior nasal passage immediately posterior to bony palate.....	4.5	-----
Distance from anterior margin of basi-occipital to foramen magnum.....	10.1	-----
Anteroposterior diameter of tympanic bulla.....	13.3	-----
Greatest transverse diameter of tympanic bulla.....	10.5	-----
Distance between bullae.....	7.0	-----
Distance from dorsal surface of supra-occipital to superior margin of foramen magnum.....	<sup>1</sup> 6.0	-----
Greatest width across occipital condyles.....	12.5	-----
Width across postorbital constriction.....	10.8	-----
Depth of anterior portion of zygomatic arch.....	5.8	-----
Greatest width across anteroventral prominences of zygomatic arches.....	30.7	-----
Length of diastema between alveoli of I <sup>3</sup> and P <sup>3</sup> .....	17.1	-----
Length of cheek tooth series, P <sup>3</sup> to M <sup>3</sup> , inclusive, measured at occlusal surface.....	10.7	11.3
Length of cheek tooth series measured along alveoli.....	12.1	12.6
I <sup>1</sup> , anteroposterior diameter.....	1.7	-----
I <sup>1</sup> , transverse diameter.....	2.3	-----
P <sup>3</sup> , anteroposterior diameter.....	<sup>1</sup> 1.4	1.6
P <sup>3</sup> , transverse diameter.....	2.6	2.7
P <sup>4</sup> , anteroposterior diameter.....	2.0	2.0
P <sup>4</sup> , transverse diameter at occlusal surface.....	4.0	4.1
M <sup>3</sup> , anteroposterior diameter.....	0.9	1.0
M <sup>3</sup> , transverse diameter.....	1.4	1.6

<sup>1</sup> Approximate.

TABLE 2.—Measurements (in millimeters) of mandible and inferior dentition

Measurement	<i>Hypolagus limnetus</i> , U.S.N.M. no. 12619 (type)	<i>Hypolagus furlongi</i> , C.I.T. no. 1321 (type)	<i>Hypolagus</i> , near <i>retus</i>		<i>Alilepus?</i> <i>vagus</i> , U.S.N.M. no. 12622 (type)
			U.S.N.M. no. 12620	U.S.N.M. no. 12621	
Depth of mandible below M <sub>1</sub> , measured on inner side.....	11.4	10.6	14.8	-----	-----
Thickness of mandible below M <sub>1</sub> .....	4.3	4.2	5.7	-----	-----
Length of diastema between I and P <sub>3</sub> .....	13.0	11.0	-----	17.0	15.2
Length of cheek tooth series, P <sub>3</sub> to M <sub>3</sub> , inclusive, measured at occlusal surface.....	11.6	-----	-----	-----	-----
Length of cheek tooth series, measured along alveoli.....	12.9	-----	18.0	-----	-----
I, anteroposterior diameter.....	2.1	1.9	-----	2.5	<sup>1</sup> 3.0
I, transverse diameter.....	2.3	2.2	-----	3.0	<sup>1</sup> 3.7
P <sub>3</sub> , anteroposterior diameter.....	2.7	2.5	-----	3.3	3.5
P <sub>3</sub> , transverse diameter.....	2.3	2.4	-----	3.0	3.2
M <sub>1</sub> , anteroposterior diameter.....	2.4	2.2	3.0	-----	-----
M <sub>1</sub> , transverse diameter.....	2.7	2.6	3.5	-----	-----
M <sub>3</sub> , anteroposterior diameter.....	1.8	-----	-----	-----	-----
M <sub>3</sub> , transverse diameter.....	1.7	-----	-----	-----	-----

<sup>1</sup> Approximate.







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## PARASITES OF FISHES IN GALVESTON BAY

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DURING THE summer of 1933 a survey of the fish fauna of certain selected localities in Galveston Bay on the Texas coast was made by A. W. Collier. A considerable number of specimens were supplied me for parasitological examination, and I examined 23 host species, the individual specimens of each varying from 1 to over 100. Some were obtained from localities in the lower part of the bay, others from near the head of the bay. In the following instances an apparently significant difference in parasite fauna in the two localities was observed: (1) The tapeworm larva *Glossocercus cyprinodontis*, new genus and species, was found in considerable numbers in *Cyprinodon variegatus* in lagoons on Galveston Island but not in the upper parts of the bay; (2) the acanthocephalan *Atactorhynchus verecundus*, new genus and species, was found commonly in *Cyprinodon variegatus* in upper parts of the bay but very sparsely in specimens from Galveston Island; (3) the acanthocephalan *Rhadinorhynchus tenuicornis* Van Cleave was found very commonly in several species of fishes in lower parts of the bay but was not met with in fishes from the upper bay. These differences are probably associated with the local distribution of an avian definitive host in the first instance and of arthropod intermediate hosts in the other instances.

There are a number of striking features in connection with the parasite fauna in general: (1) A great excess of immature over adult stages of parasites; (2) a scarcity of flukes and of adult tape-

worms; and (3) a predominance of Acanthocephala as common adult parasites. Twenty-five species of parasites were identified, but 15 of these are larval or immature stages. Of the 10 adults found, 9 are described as new, whereas of the 15 immature forms 11 are described as new, although some of them may prove to be the larvae of already described adult forms.

The flukes are conspicuous by their sparseness. Only one immature and two adult flukes were found. This is clearly correlated with the almost complete absence of gastropods in the bay; only one form, a species of *Littorina*, was found, and this in only one small portion of the bay. The immature fluke found is a gasterostome, which in all probability utilizes a bivalve as an intermediate host.

The tapeworms are represented by two adult and six larval forms. The two adults are both species of *Proteocephalus*, and both found in *Lepisosteus*. Four of the larvae (three tetra-rhynchids and one *Scolex*) are larval forms of fish parasites, while two (a *Glossocercus* and a cysticeroid) are probably the larvae of bird parasites.

The nematodes are represented by only three adult forms, all of which are rare, and by eight immature forms, all but two of which belong to the Anisakinae. Most of these forms were found repeatedly in certain hosts, and seemed to be fairly closely limited to these hosts, but two of them, *Rhaphidascaris anchoviellae* and *Contracaecum collieri*, were found in several different hosts. A peculiar hostal distribution was noted in the two species of *Contracaecum* found. One of these, *C. collieri*, was found commonly in *Cyprinodon variegatus*, and once each in *Sciaenops ocellatus* and *Paralichthys lethostigmus* but never in *Fundulus*; the other, *C. robustum*, was found commonly in *Mugil cephalus* and fairly frequently in *Fundulus*, but not in *Cyprinodon*.

The Acanthocephala are the commonest adult parasites of fishes in Galveston Bay. The three adult species found were all fairly common in their respective hosts; they were the only adult parasites that one could depend upon finding in repeated examinations of particular hosts. In addition to the adult forms, one immature form, which probably reaches maturity in a bird, was found.

Table 1 gives a list of the hosts examined and the parasites found.

TABLE 1.—*Hosts examined and parasites found*

Host	Part of bay <sup>1</sup>	Number examined	Parasites	Number infected
<i>Amphotistius sabinus</i> .....	L	1	.....	.....
<i>Lepisosteus osseus</i> .....	L	2	<i>Proteocephalus australis</i> .....	2
	U	1	<i>P. elongatus</i> .....	1
<i>Elops saurus</i> .....	U	6	.....	.....
<i>Brevoortia tyrannus</i> .....	U	2	.....	.....
<i>Dorosoma cepedianum</i> .....	L	7	Unidentified tapeworm larva.....	1
<i>Anchoviella epsetus</i> .....	L	3	<i>Amphicaecum parvum</i> .....	1
	L	2	<i>Rhaphidascaris anchoviellae</i> .....	3
<i>Bagre marina</i> .....	U	4	<i>Tentacularia lepida</i> .....	1
			Unidentified tetrarhynchid.....	1
			<i>Scolex pleuronectis</i> .....	3
			<i>Goezia minuta</i> .....	1
	L	3	<i>Tentacularia lepida</i> .....	1
			<i>Gymnorhynchus gigas</i> .....	1
			<i>Scolex pleuronectis</i> .....	2
<i>Galeichthys felis</i> .....	U	5	<i>Tentacularia lepida</i> .....	2
			<i>Gymnorhynchus gigas</i> .....	2
			<i>G. malleus</i> .....	1
			<i>Scolex pleuronectis</i> .....	3
			<i>Gorgorhynchus gibber</i> .....	2
<i>Ictalurus furcatus</i> .....	U	1	<i>Agamonema vomitor</i> .....	1
			<i>Dichelyne diplocaecum</i> .....	1
<i>Fundulus heteroclitus</i> .....	U	20	<i>Agamonema immanis</i> .....	3
	L	100	<i>Contracaecum robustum</i> .....	5
			<i>Glossocercus cyprinodontis</i> .....	15
			<i>Contracaecum collieri</i> .....	20
<i>Cyprinodon variegatus</i> .....	U	40	<i>Atactorhynchus verecundus</i> .....	2
			<i>Agamonema immanis</i> .....	3
			<i>Contracaecum collieri</i> .....	6
			<i>Atactorhynchus verecundus</i> .....	10
<i>Mollienesia latipinna</i> .....	L	20	.....	.....
<i>Paralichthys lethostigmus</i> .....	U	2	<i>Scolex</i> sp.....	1
			<i>Contracaecum collieri</i> .....	1
			<i>Arhythmorhynchus duocinctus</i> .....	1
			<i>Rhipidocotyle transversale</i> .....	2
<i>Menidia menidia</i> .....	U	6	Unidentified fluke.....	2
			<i>Cysticercoides menidia</i> .....	2
			<i>Rhaphidascaris anchoviellae</i> .....	1
<i>Mugil cephalus</i> .....	L	18	<i>Contracaecum robustum</i> .....	16
	U	8	do.....	5
<i>Polynemus odonemus</i> .....	L	3	<i>Rhadinorhynchus tenuicornis</i> .....	1
			<i>Lecithochirium microstomum</i> .....	3
<i>Trichiurus lepturus</i> .....	L	3	<i>Porrocaecum trichiuri</i> .....	2
			<i>P. secundum</i> .....	1
			<i>Rhaphidascaris anchoviellae</i> .....	1
<i>Lagodon rhomboides</i> .....	L	16	.....	.....
	U	5	.....	.....
<i>Archosargus probatocephalus</i> .....	L	5	.....	.....
<i>Sciaenops ocellatus</i> .....	L	6	<i>Contracaecum collieri</i> .....	1
	U	1	<i>Dichelyne fastigatus</i> .....	1
<i>Leiostomus xanthurus</i> .....	L	3	<i>Rhadinorhynchus tenuicornis</i> .....	2
	U	3	.....	.....
<i>Micropogon undulatus</i> .....	L	16	<i>Rhadinorhynchus tenuicornis</i> .....	12
	U	7	<i>Gymnorhynchus gigas</i> .....	1
<i>Erisicion nebulosus</i> .....	L	4	Unidentified tapeworm larva.....	1

<sup>1</sup> L, lower; U, upper.

## Class TREMATODA

## Family BUCEPHALIDAE Poche, 1907

*Rhipidocotyle transversale*, new species

## PLATE 6, FIGURE 1

*Description of immature forms encysted in Menidia.*—Size 0.45 by 0.24 mm to 1.22 by 0.5 mm. Body oval with broadest region near middle. Anterior half of body covered by minute spines in transverse rows; posterior part of body with spines inconspicuous, embedded in cuticle. Anterior sucker with its forward-projecting structure cuspidor-shaped; sucker  $160\mu$  to  $185\mu$  in diameter, base of sucker  $200\mu$  to  $265\mu$  from anterior end. Very young specimens have a mass of glandular material in anterior end of body (=“cystogenous organ” of Tennent, 1906, and “penetration organ” of Woodhead, 1929). Anterior sucker develops in midst of this mass, and vitelline follicles from posterior part of it. Pharynx about two-fifths length of body from anterior end, about  $90\mu$  to  $100\mu$  in diameter, without prepharynx. Intestine egg-shaped or nearly spherical, in large specimen about  $310\mu$  in diameter. Testes round or oval, side by side or diagonally situated, somewhat posterior to center of body; size variable, up to  $175\mu$  in diameter. Cirrus pouch about  $250\mu$  to  $350\mu$  long and  $70\mu$  to  $125\mu$  in diameter, with a small seminal vesicle at its proximal end, about  $50\mu$  long. Genital atrium large, in a large specimen  $180\mu$  long and  $120\mu$  in diameter, often nearly filled by the partially everted cirrus. Ovary smaller than testes, usually oval, up to  $95\mu$  by  $130\mu$ , situated beside or diagonally in front of anterior testis. Developing uterus present in older specimens, with several twists or loops, entering genital atrium beside cirrus. Vitelline follicles 32 in number, arranged transversely, and not separated into two distinct groups but connected across median line just posterior to anterior sucker.

*Host.*—*Menidia menidia*.

*Location.*—In walls of intestine.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39516; paratypes, no. 39517.

*Remarks.*—*Rhipidocotyle transversale* differs from other members of the genus in the form of the anterior sucker and its forward-projecting structure and in the arrangement of the vitellaria, which in all other forms are arranged in two lateral groups. It appears to be identical with the form figured by Linton (1901, pl. 34, figs. 367, 368) as “*Gasterostomum* sp. from *Tylosurus marinus*”, but it is not the same as the one that he recorded from this host at Beaufort,

N. C., and that Tennent (1906) erroneously referred to as *Gastrostomum gracilescens*; the Beaufort form is apparently *Bucephalopsis haimeana*.

The last-mentioned species was recorded by Tennent (1906) in a metacercarial state in washings from the stomach and intestine of *Menidia*. When viscera of infected *Menidia* were fed to carnivorous fishes, some further development of the young flukes took place. The first intermediate host of this parasite was found to be the oyster, and it is not improbable that the same is true of the species here described. The method of infection of *Menidia* is uncertain; the occurrence of the young flukes in the walls of the intestine makes it highly probable that the cercariae, liberated from sporocysts in a bivalve host, are swallowed by the *Menidia*. In the case of a related fresh-water bucephalid, *Bucephalus papillosus* (referred to the genus *Rhipidocotyle* by Eckmann, 1932), the cercariae liberated from fresh-water mussels (Unionidae) penetrated the flesh of young bass at the base of the fins and encysted there (Woodhead, 1929).

### Family HEMIURIDAE Lühe, 1901

#### LECITHOCHIRIUM MICROSTOMUM, new species

#### PLATE 6, FIGURES 2, 3

*Specific diagnosis*.—Specimens with ripe eggs and caudal appendage retracted are 2.75 to 4.8 mm long, with maximum width of 0.875 to 1 mm. One individual with extended caudal appendage measures 3.76 by 0.63 mm; appendage about 1 mm long. Cuticle without spines or rings. Maximum width at about level of vitelline glands or behind them. Oral sucker 140 $\mu$  to 200 $\mu$  in diameter, without internal lateral protuberances. A deep sinus present on ventral surface of body between ventral sucker and genital opening, and a special small round depression, characteristic of genus, just anterior to ventral sucker. Ventral sucker 365 $\mu$  to 540 $\mu$ ; ratio between size of oral and ventral suckers, 1:2.5 to 1:2.8. Pharynx round, 70 $\mu$  to 110 $\mu$  in diameter, contiguous with oral sucker, and followed by swollen, nearly spherical esophagus about same size as pharynx. Intestinal ceca pass laterally to sides of body, at right angles to long axis of body, then turn and pass posteriorly, ending at about level of retracted appendage. Disposition of genital glands as usual, testes close together and obliquely situated. Ovary farther behind testes than testes are behind ventral sucker. Yolk glands at level of or immediately behind ovary, each with three or four lobes, which are scarcely if any longer than wide. Uterus fairly voluminous, occupying most of space around testes and between testes and ovary, and with loops extending posterior to ovary and yolk glands, on left

side in two specimens, on right in one (pl. 6, fig. 2). Uterus forms metraterm at level of ventral sucker, the two parts separated by a well-developed sphincter (pl. 6, fig. 3). Metraterm pursues fairly straight course to sinus on ventral surface of body, then bends ventrally and joins prostatic part of vas deferens to form thick-walled hermaphroditic duct. Prostatic part of vas deferens saclike, constricted into two portions and connected with large trilobed seminal vesicle by narrow duct surrounded by numerous prostate cells. Eggs  $16\mu$  by  $12\mu$ .

*Host*.—*Trichiurus lepturus*.

*Location*.—Stomach.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39518; paratype, no 39521.

*Remarks*.—Only one other species of this genus as restricted by Looss (1907) has hitherto been described from American fishes with sufficient accuracy to be specifically recognizable, namely, *L. synodi* Manter (1931), although some of the forms referred by Linton (1898, 1901, 1905) to *Distomum monticellii* may be species of *Lecithochirium* and may even be identical with the form here described. *L. microstomum* differs from *L. synodi* in the greater relative difference in size of the suckers, in the presence of a bladder in the prostatic part of the vas deferens just behind the hermaphroditic duct, and in the larger size of the eggs. These flukes were found in small numbers in two out of three specimens of *Trichiurus lepturus*.

#### UNIDENTIFIED DISTOME

##### PLATE 6, FIGURE 4

A few specimens of an unidentified distome, which may be identical with Linton's "*Distomum* sp. from *Menidia notata*" (1901, pl. 32, figs. 357, 358), were found in *Menidia menidia* along with *Rhipidocotyle transversale*. The specimens were extremely fragile, with a tendency to stick to glass during the process of preparation, and were so densely crowded with eggs that no organs except the suckers and pharynx could be identified. The flukes are about 0.48 to 0.7 mm long, with greatest transverse measurement from dorsal to ventral side through ventral sucker. Ventral sucker in large specimen (0.7 mm long)  $140\mu$ , oral sucker  $70\mu$ , pharynx  $50\mu$ . Eggs about  $22\mu$  by  $12\mu$ .

## Class CESTODA

## Family TETRARHYNCHIDAE Cobbold, 1864

## TENTACULARIA LEPIDA, new species

## PLATE 7

*Specific diagnosis.*—Head and neck very long and slender, with an annular constriction immediately behind contractile bulbs where neck joins tail-like blastocyst. Two lateral heart-shaped bothria, emarginate behind, about  $550\mu$  long, and  $450\mu$  to  $550\mu$  wide at posterior end. Head and neck anterior to bulbs (pars vaginalis) 2.5 to 3 mm long. Just behind bothria neck only about  $135\mu$  to  $170\mu$  broad in lateral view; neck flares a little in bulbar region, reaching diameter of  $320\mu$  to  $540\mu$  at postbulbar constriction. Tail-like blastocyst 1.5 to 2.5 mm long, nearly cylindrical, with diameter of  $300\mu$  to  $350\mu$ . Contractile bulbs about  $400\mu$  to  $500\mu$  long and about  $120\mu$  broad, very close together, and collectively forming pear-shaped body. Each bulb with dense mass of fibers on inner wall; thickness of these muscular masses increases to a maximum at a point about two-thirds distance from anterior to posterior end, and then decreases again. A few fibers cross through central area between bulbs, holding latter together in a compact manner. Appearance and structure of bulbs as in plate 7, figures 1, 2, 5, and 6. Slender proboscis retractors attached anteriorly on inner wall of bulbs. Proboscides estimated to be between 1.5 and 2 mm long, cylindrical, with diameter of about  $45\mu$  to  $50\mu$ , armed with hooks of various kinds, form and arrangement of which are shown in plate 7, figure 4. Largest hooks in each spiral arranged in two groups of five hooks each, three elongate and only moderately curved, and two shaped somewhat like a cat's claw and sheath. At point where claw joins sheath these hooks very broad dorsoventrally and very thick. On side of proboscis opposite these two sets of hooks a single row of small round plates, in a continuous series, two plates to each whorl of hooks. On either side of this row of plates a close group of three slender spines, and between these and the three slender hooks of each group of five a single very slender spine. Maximum length attained by any hooks about  $20\mu$ . Little difference in size or arrangement of hooks on different parts of proboscides. Proboscis sheaths coiled in characteristic manner throughout length of neck. Numerous granular bodies in neck about  $20\mu$  in diameter; these begin about one-fourth length of neck behind bothria and continue to anterior ends of contractile bulbs, being somewhat more numerous posteriorly; granular bodies for most part apparently round and sessile (pl. 7, fig. 3) but actually attached to walls of neck by slender stalks, and closely similar to granular bodies



figured by Southwell (1930, fig. 57, B), on bulbs of his *Gymnorhynchus malleus*. Similar granular bodies are described and figured by Linton (1897) in the neck of his *Rhynchobothrium speciosum* (= *Tentacularia speciosa*).

*Type host*.—*Galeichthys felis*.

*Location*.—Attached to mesenteries.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39519; paratypes, no. 39520.

*Remarks*.—Only the encysted larvae of this form have been found; these occur in moderate numbers attached to the mesenteries of two species of catfish, *Galeichthys felis* and *Bagre marina*. The scolex and tail-like postbulbar portion appear to be free in the cysts, since when the cysts are broken and pressure is applied, the enclosed larva emerges entirely unattached. The cysts are usually pear-shaped and 2 to 4 mm long.

*Tentacularia lepida* is closely related to *T. speciosa* (Linton, 1897) and to *T. spiracornuta* (Linton, 1907). *T. speciosa* has recently been transferred to a new genus, *Lintoniella*, by Yamaguti (1934), but the reasons for its establishment seem to me inadequate. If, however, this genus is accepted, both *spiracornuta* and *lepida* should be placed in it. The armature of the proboscides of *lepida* is strikingly similar to that of *spiracornuta* as figured by Southwell (1930) and that of *speciosa* as figured by Yamaguti (1934), but *lepida* is much smaller than either of these, with differences in the proboscis hooks, proboscis sheaths, and contractile bulbs that clearly indicate specific distinctness.

#### GYMNORHYNCHUS GIGAS (Cavier, 1817)

##### PLATE 8, FIGURES 1-4

Southwell (1930) has shown that this is the correct name for a tetrarhynchid that has hitherto been known as *Synbothrium fragile* Diesing, 1850, or *Syndesmobothrium fragile* Diesing, 1855. Linton (1897) described a second species of *Synbothrium* (*S. filicolle*) that he obtained in the larval state from a considerable number of fishes. In 1908 he briefly described an adult tetrarhynchid from a sting ray and assigned it to the same species. This adult, however, was probably incorrectly identified, for the dimensions given for the head, contractile bulbs, and other parts do not correspond with those of the larvae. Southwell believes that Linton's *S. filicolle* and Diesing's *S. fragile*, as well as *S. hemuloni* MacCallum, 1921, are all the same species, and with this I agree. Southwell, however, also considers *Tetrarhynchus platycephalus* Shipley and Hornell, 1906, to be the adult of the same species. This, I believe, is a mistake, for the characters of the head of this worm are strikingly different from

those of *Gymnorhynchus gigas*. Further remarks on *Tetrarhynchus platycephalus* will be found in the discussion of *Gymnorhynchus malleus*.

Three specimens of larval tetrarhynchids (U.S.N.M. no. 39522) from Galveston Bay fishes have been assigned to this species; two were found encysted on the mesenteries of *Galeichthys felis*, a single one in each of two hosts, while the third was found encysted in the body cavity of a croaker (*Micropogon undulatus*). When the cysts were burst the very characteristic larvae were freed; these larvae consist of a head and neck, followed by a nearly spherical vesicle into which the head and neck may be withdrawn, and then a long tail-like portion. Such larvae, probably all belonging to the same species, have been figured under the names *Gymnorhynchus reptans* and *Anthocephalus macrourus* by Bremser (1824); under the name *Pterobothrium heteracanthum* by Diesing (1855); as a "*Tetrabothrium* larva" by Linton (1887); as a *Syndesmobothrium filicollis* by Linton (1889); and as *Gymnorhynchus gigas* by Southwell (1930). The larvae reported by Southwell that lack a vesicle in the neck should not, I think, be referred to this species. Dollfus (1929b) considers *Pterobothrium* Diesing, 1850 (later renamed *Synbothrium* and still later *Syndesmobothrium*) as a valid genus distinct from *Gymnorhynchus*, but his reasons for doing so are not clear.

Since there is so much confusion with respect to this species it seems desirable to describe some of the details of the specimens found in Galveston Bay fishes, and then to point out the features actually characterizing the species.

The vesicle in which the scolex lies measures, in my specimens, 2.5 to 3.5 mm in length and is about three-fourths as wide as long. The relations of scolex, vesicle, and "tail" are precisely as described by Linton in 1887. The tail is several centimeters in length and about 0.75 mm in breadth. The four bothria are mobile, spreading from the front of the head, each with a sucking disk; they measure about 300 $\mu$  in an anteroposterior direction, while the width of the head across the bothria is about 450 $\mu$  to 470 $\mu$ . The neck anterior to the contractile bulbs (pars vaginalis of Pintner, 1913) is 2.4 mm long and about 200 $\mu$  broad, widening out in the bulbar region to about 400 $\mu$  (pl. 8, fig. 1). The neck is slightly dilated just anterior to the bulbs, where the proboscis sheaths are coiled. The postbulbar region is shorter than the pars vaginalis but varies in my specimens from about 0.5 to 1.5 mm, according to the state of contraction. The bulbs are elongate and of nearly uniform width, measuring about 1 to 1.3 mm in length by about 135 $\mu$  in width. The total length of the proboscides, judged by the extent of the inverted spines, is about 3 mm; the diameter, exclusive of the spines, is about 60 $\mu$ . The proboscis sheaths are straight in the

greater part of the neck, becoming thrown into coils just anterior to the bulbs. The spines on the proboscides, as far as observable in the everted part, are arranged in two groups of five each. Near the base of the proboscis one set of five spines in each whorl consists of recurved clawlike spines, tending to become straight and elongate, at first one or two in a set, in more distal whorls all of them. Many of the spines near the base have more or less well-developed prongs (pl. 8, fig. 4). After the first six or eight whorls all the spines tend to become elongate, only slightly curved, and to have their prongs flattened out (pl. 8, fig. 3). Near the base these elongate spines are about  $50\mu$  to  $60\mu$  long, but they gradually grow larger until they reach a length of about  $110\mu$ . At about  $900\mu$  from the base the spines in one series of five change rather suddenly, in the space of two or three whorls, to very stout, strongly curved, clawlike spines with stout bases, the spines in the other series remaining broad, flat, elongate, and slightly sinuous (pl. 8, fig. 2). Examination of the inverted part of the proboscis shows that at least some clawlike spines continue nearly to the tip, but the form and arrangement of the spines in this part of the proboscis could not be made out clearly.

Following are the characters that I think should be possessed by a specimen before it can be correctly assigned to this species: Larvae with "blastocyst" divided into an anterior oval or spherical vesicle containing the head (unless pressed out) and an elongate, posterior tail-like portion. Head when pressed out of vesicle remains attached to it unless broken. Bothria four, spreading out anteriorly and each with a sucking disk directed forward. Head and neck 3 or more mm in length, and about  $200\mu$  broad in narrowest region; contractile bulbs about 1 mm or more in length and about one-tenth to one-eighth as wide as long. Proboscis sheaths nearly straight in anterior half or two-thirds of length of neck, but thrown into coils just anterior to bulbs. Retractable muscles of proboscides attached near anterior end of bulbs. Proboscides about 3 mm in length. Spines on proboscides arranged in two groups of five. On basal portion of proboscides, except first six or eight rows, spines slightly curved and bladeliike, frequently notched at tip, and reaching maximum length of about  $110\mu$ . About 1 mm from base, spines in one set of five change to a stout clawlike form, which is maintained in at least one set of spines to tips of proboscides.

GYMNORHYNCHUS MALLEUS (Linton, 1924)

PLATE 8, FIGURES 5, 6

The larvae of this species were described and figured by Linton (1897) as *Tetrarhynchus erinaceus*. These larvae were transferred by Linton in 1905 to the genus *Synbothrium*, and in 1924 were as-

signed to the species *S. malleum*, the adult of which he described in that year, parasitic in the ray *Dasybatis centrura*. The larvae were found in a number of salt-water fishes, including *Galeichthys milberti*. Southwell (1930) referred to this species some adult specimens, which he found in rays in Ceylon. Two specimens (U.S.N.M. no. 39523), which I have assigned to this species, were obtained from the mesenteries of *Galeichthys felis*.

My specimens seem to agree fairly closely with Linton's description and figures of this species except for the smaller size. Unfortunately the proboscides are only slightly exerted, so a full comparison of their armature with that described and figured by Linton is not possible. So far as can be seen, however, my specimens agree with Linton's.

The cysts have an enlarged egg-shaped anterior end measuring about 4 to 5 mm in length and 2.5 mm in breadth. Behind this anterior portion there is a long tail-like appendage. The scolex and neck, and a bulblike expansion of the body behind the neck, are contained in the enlarged anterior portion of the cyst. The tail consists of a slender prolongation of the body covered by a loose thin sheath, which is a part of the cyst wall. The tail in one specimen is about 17 mm long and in the other about 50 mm. The bothria spread out at right angles to the long axis, giving the hammerlike appearance that has been described and figured by Linton. The breadth of the head across the bothria is about  $850\mu$ , and the length of the bothridial portion of the head only about  $350\mu$ . A proboscis emerges from near the outer extremity of each bothrium, but none of the proboscides are exerted far enough to show more than one or two basal rows of hooks. The visible hooks consist of very stout thorn-shaped hooks, slender recurved hooks, and numerous minute spines. The proboscides are about 2 mm in length, with a diameter at the base of about  $40\mu$ . The short thick neck is about  $560\mu$  in diameter. The contractile bulbs are about 1.2 mm long and  $270\mu$  abroad.

Shipley and Hornell (1906) described and figured under the name *Tetrarhynchus platycephalus* an adult tetrarhynchid that had the head shaped strikingly like *G. malleus*, but in which the hooks as described are like those of *G. gigas*. In Shipley and Hornell's worm, however, the short proboscides are nearly straight within the head and posteriorly pass to the posterior extremity of the contractile bulbs, in which they lie coiled. In my specimens no such condition exists; the retractor muscles of the proboscides are attached to the anterior ends of the bulbs. It seems certain, therefore, that *T. platycephalus* is identical with neither *G. gigas* nor *G. malleus*, but should be recognized as a third species of *Gymnorhynchus*, *G. platycephalus*.

## Superfamily PHYLLOBOTHRIOIDEA Southwell, 1930

SCOLEX PLEURONECTIS Müller, 1788 (S. POLYMORPHUS Rudolphi, 1819, of many writers)

Larval cestodes of this species have been found in a great number of different marine fishes and show a considerable variation in size and form, but the variation among the individuals in a single host and changes that are thought to take place with age make it extremely difficult, and at present impossible, to separate different species with any degree of accuracy. These worms have been considered to be the larval forms of various tetracanthellid worms by different authors; among the supposed parent worms are species of *Acanthobothrium*, *Calliobothrium*, *Onchobothrium*, *Echeneibothrium*, and *Phoreiobothrium*. Experimental feedings of the larvae to elasmobranch hosts have been made by Monticelli (1888) and Curtis (1911). Monticelli, feeding larvae from a flounder (*Arnoglossus*) near Naples to a species of *Torpedo*, obtained young specimens of *Calliobothrium filicollis*, which he believed to have developed from the larvae fed. Curtis, on the other hand, fed larvae obtained from *Cynoscion regalis* at Woods Hole, Mass., to *Carcharias littoralis* and obtained young specimens of *Phoreiobothrium triloculatum*, which he believed to have been derived from the experimental feeding. Southwell (1925) sums up the situation as follows: "There can, I think, be little doubt that the name *Scolex polymorphus* does not indicate a definite species; it is a group name which includes a number of different species in the final host."

Linton in his various papers has noted the occurrence of these larval cestodes, which he lists under the name *Scolex polymorphus*, in over 60 widely diversified species of fish. In some hosts (e. g., *Cynoscion regalis* in New England) they were found in almost every specimen examined and in enormous numbers, either in the cystic duct and gall bladder or in the intestine, or in both. The forms described from various fish hosts are by no means all alike. They differ in size, in the form of the sucker, or "myzorhynchus", at the anterior end between the bothria, in the size and shape of the bothria, in the presence or absence of cross partitions, or "costae", on the bothria (one to four in number when present), and in the presence or absence of red pigment patches. Linton (1905) records this parasite from *Galeichthys milberti* at Beaufort, N. C. Twelve specimens were obtained from the cystic duct near its junction with the intestine. Of these Linton says: "The specimens contracted freely between 4 and 8 mm in length. At rest, with bothria retracted, the length was about 1.2 mm. There was no indication of costae on the bothria nor of the red pigment patches often noted in these larval cestodes." Similar specimens were found in the intestine of another host of the same species.

My specimens were found in three of five specimens of *Galeichthys felis* taken at Evergreen Beach in Galveston Bay and in two of three specimens taken in the Gulf of Mexico near Bolivar Point, Galveston. Similar larvae were found in several specimens of *Bagre marina*. In most instances the parasites were present in moderate numbers, from 8 or 10 to 30 or 40, attached to the cystic duct, free in the gall bladder, or free in the chyle of the intestine. While living they were extremely active, extending to a length of 6 to 8 mm and becoming as slender as a thread, with a slight enlargement just behind the head, and contracting down to less than 1 mm in length. There was a very marked tendency, when the worms contracted slightly from a fully extended condition, for the body to bulge conspicuously just behind the head. After fixation the worms contracted to a length of 2 to 4.5 mm, with a maximum diameter behind the head varying from 0.1 to 0.6 mm. Across the widest region of the bothria the head measures 0.4 to 0.65 mm. The bothria are 0.23 to 0.3 mm long and about half as wide. The apical sucker, or "myzorhynchus", is flat anteriorly and rounded posteriorly, about as long as wide, and about 0.07 mm in diameter.

### Family PROTEOCEPHALIDAE La Rue, 1911

#### PROTEOCEPHALUS AUSTRALIS, new species

#### PLATE 9, FIGURES 3-6

*Specific diagnosis.*—Total length 20 to 38 cm, with maximum diameter of about 1 mm when relaxed, but up to 1.8 mm in contracted regions. Head not clearly demarcated from strobila; maximum diameter, shortly behind suckers, about 780 $\mu$  (pl. 9, fig. 6). Suckers face anterolaterally and are about 285 $\mu$  in diameter without deep grooves between them. Anterior end with vestigial sucker. Segmentation begins immediately behind scolex. Narrowest part of neck about 665 $\mu$  broad. Proglottids in various regions of strobila with measurements in millimeters as follows:

	Length	Breadth
5 mm from anterior end.....	0.045	0.75
10 mm from anterior end.....	0.1	0.77
25 mm from anterior end.....	0.3	1
50 mm from anterior end.....	0.7	1.33
75 mm from anterior end.....	1.2	1.8
100 mm from anterior end.....	2	0.75
Longest proglottid.....	2.65	1

In relaxed condition all proglottids over 100 mm from anterior end longer than broad. Posterior segments split on mid-ventral line, and with tendency to pull apart at junctions, remaining attached only at lateral margins, leaving fenestrae between them. Calcareous granules very numerous, angular in outline, and about 5 $\mu$  in diameter.

Genital pore marginal, at bottom of well-developed sinus, irregularly alternating, one-fourth or less of length of proglottid from anterior end. Testes 90 to 100, about  $50\mu$  to  $70\mu$  in diameter, occupying greater part of proglottid between vitellaria, except space occupied by other organs. Vas deferens forms dense mass of coils lying median and slightly posterior to cirrus pouch (pl. 9, fig. 3).

Cirrus pouch large,  $450\mu$  to  $530\mu$  long and  $240\mu$  to  $265\mu$  broad, of variable shape. After entering pouch vas deferens makes about three loops, then rather suddenly enlarges to form cirrus. Retracted cirrus extends almost to proximal end of pouch and then twists forward and distally to junction with vas deferens; wall thick and thrown into conspicuous corrugations. Exserted cirrus extremely long, up to 1.5 mm when fully exserted, about  $100\mu$  in diameter at base, tapering to diameter of  $40\mu$  at truncated tip (pl. 9, fig. 5). Vagina, opening just anterior to cirrus, forms crescentic curve with convex side forward, about  $300\mu$  long (pl. 9, figs. 3, 5). Distal  $40\mu$  or  $50\mu$  of duct with moderately thick walls, rest of curve surrounded by powerful sphincter muscle, thickest on middle of convex side of curve; maximum diameter of vagina through sphincter about  $90\mu$  to  $110\mu$  with narrow lumen, not more than  $5\mu$  or  $6\mu$  in diameter when open. At end of curved sphincter region vagina opens into expanded thin-walled tube with lumen usually about  $80\mu$  to  $90\mu$  in diameter at junction with sphincter, sometimes bulged to diameter of  $120\mu$ . This tube passes toward median line of segment, curving posteriorly, and then passes back to ovary, its direction frequently interrupted by kinky folds. When empty, diameter of this portion of vagina only about  $20\mu$  to  $25\mu$  but frequently expanded to a diameter of  $40\mu$  or  $50\mu$ . Coils not noticeably more numerous just anterior to ovary. Behind ovary oviduct and vagina thrown into several transverse loops, which could not be successfully followed. Ovary bilobed, usually of rather characteristic shape (pl. 9, figs. 3, 4), its posterior border almost straight, extending to vitellaria on each side; anterior border a deep-swinging curve, each end not quite reaching vitellaria, having lateral borders nearly straight and at right angles to posterior border but with anterior tips bent inward. Greatest anteroposterior diameter of ovary, from tips of anterior curve to posterior border, about  $400\mu$  to  $450\mu$ . Vitellaria extend from near anterior border of segment to near posterior border of ovary on aporal side, and from posterior side of cirrus pouch to posterior border of ovary on poral side, only rarely any follicles present anterior to cirrus pouch. Uterus spreads laterally, maintaining almost straight lateral borders; about 15 to 20 incomplete septa on each side tend to divide uterus into lobes (pl. 9, fig. 4).

*Type host.*—*Lepisosteus osseus*.

*Location.*—Intestine.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39525.

*Remarks.*—This species comes strikingly near to *P. ambloplitis* Leidy as described and figured by Benedict (1900), although it looks much different from specimens examined by me taken from *Microp-terus dolomieu* in Douglas Lake, Mich., and referred to that species by LaRue. No other member of the genus *Proteocephalus* except *P. ambloplitis* as described by Benedict has a vaginal sphincter even approaching that of the species here described (LaRue, 1914).

*P. australis* differs from *P. ambloplitis* as described by Benedict in the following particulars: In *P. ambloplitis* all the segments, except sometimes a few square posterior ones, are broader than long; in *P. australis* all proglottids beyond  $75\mu$  to  $100\mu$  from head are longer than broad, some over two and one-half times longer. In *P. ambloplitis* the scolex is sharply set off from the neck, which in Benedict's figures appears to be only  $300\mu$  to  $400\mu$  broad, and the suckers are separated by deep sulci; in *P. australis* the scolex is hardly broader than the neck, and there are no sulci between the suckers. In *P. ambloplitis* the inner longitudinal muscles are arranged in 50 to 60 distinct bundles; in *P. australis* these muscles are not distinctly segregated into bundles. In *P. ambloplitis* the vas deferens is intricately coiled in the cirrus pouch, and the protruded cirrus measures about  $500\mu$  to  $700\mu$  in length; in *P. australis* the vas deferens has only about three loops inside the cirrus pouch, and the protruded cirrus has a length of 1.5 mm. In *P. ambloplitis* the vitellaria are described and figured as extending anterior to the cirrus pouch on the poral side; in *P. australis* they rarely do this. In *P. ambloplitis* the ovaries are described as retort-shaped and figured as narrow anteroposteriorly; in *P. australis* each lobe laterally is about as broad anteroposteriorly as it is transversely. So far *P. ambloplitis* has been recorded from various species of bass and from the bowfin (*Amia calva*) in fresh-water lakes and streams while *P. australis* was found in a gar in the highly brackish water of Galveston Bay. Two specimens were found in one of three host specimens examined.

PROTEOCEPHALUS ELONGATUS, new species

PLATE 8, FIGURES 7, 8; PLATE 9, FIGURES 1, 2

*Specific diagnosis.*—Total length about 560 mm. Head  $675\mu$  to  $765\mu$  in diameter with an apical prominence, very prominent suckers and deep sulci between suckers extending back on neck to a point about  $800\mu$  to  $900\mu$  from anterior end (pl. 8, fig. 7). Suckers about



320 $\mu$  in diameter. Head sharply constricted behind suckers. Neck long, segmentation beginning to show faintly at 5 to 9 mm from anterior end, with minimum width of 360 $\mu$  to 450 $\mu$ . Proglottids at first much broader than long, but relative length rapidly increasing until, at a distance of 4 cm from head, they may be approximately square if in an uncontracted state. Even mature segments 10 or 12 cm from head vary greatly in measurements according to state of contraction, some being broader than long (1.8 mm broad by 1.2 mm long), others longer than broad (1.2 mm broad by 2.1 mm long). Ripe segments longer than broad, varying in breadth from about 1.2 to 1.5 mm and in length from 2.8 to 4.7 mm.

Genital pores marginal, without papillae, irregularly alternating, about one-fifth to two-ninths length of segment from anterior end. Testes very numerous, about 200 to 225 or more, 60 $\mu$  in diameter, arranged almost all in one plane, and filling in greater part of space between vitellaria anterior to ovary, although soon crowded out of middle portion of segment posterior to cirrus by developing uterus (pl. 9, fig. 1). Vas deferens forms dense mass of coils lying between cirrus pouch and median line of proglottid. Cirrus pouch roughly three-eighths width of segment, measuring about 480 $\mu$  to 580 $\mu$  in length by 260 $\mu$  to 325 $\mu$  in diameter. Retracted cirrus bent upon itself in pouch; ejaculatory duct capable of great distention, which makes the walls appear thin instead of thick and muscular (pl. 8, fig. 8, A). Everted cirrus about 600 $\mu$  to 650 $\mu$  long, with bulblike enlargement of proximal half; diameter through bulb about 180 $\mu$  (pl. 8, fig. 8, B).

Vagina opens anterior to cirrus and lies close along anterior wall of latter. It is provided with an elongated muscular sphincter, somewhat reminiscent of that of *P. ambloplitis*, extending from genital pore to about half length of cirrus pouch. Musculature not nearly so thick as in *P. ambloplitis*, thickest near middle of its length and gradually disappearing instead of ending abruptly as in *ambloplitis* (pl. 8, fig. 8; pl. 9, fig. 1). Whole vagina, including part with muscular wall, may be greatly distended, although the sphincter causes a slight constriction in it (pl. 8, fig. 8, A). In young mature segments vagina, after reaching middle of proglottid, passes almost straight posteriorly to ovary, although in older proglottids it has a few kinks (pl. 9, fig. 1). Over bridge of ovary vagina has slight club-shaped enlargement from which lower vagina emerges and after one or two loops enters oviduct near middle of its length (pl. 9, fig. 2). Oviduct originates in oocapt attached to bridge of ovary. Just before entering ootype oviduct is joined by a common vitelline duct, which has a reservoirlike enlargement before it branches to go to opposite sides of segment. Shell gland surrounding ootype an

irregularly shaped mass of cells. Vitellaria arranged in two narrow lateral bands extending throughout length of proglottid on both sides. Uterus grows out from midline in form of numerous pouches separated only by wall-like partitions; pouches 20 to 30 on each side extending laterally in ripe proglottids to vitellaria.

*Type host.*—*Lepisosteus osseus*.

*Location.*—Intestine.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39526.

*Remarks.*—This worm differs from all other members of the genus except *P. ambloplitis* and *P. australis* in the size and extent of the vaginal sphincter, but the musculature of this organ is very much thinner than in either of these species. It differs further from both these species in having a slender unsegmented neck several millimeters long.

Three specimens of this worm were found in a specimen of *Lepisosteus osseus*, along with two specimens of *P. australis*. In one worm some interesting abnormalities occurred. In a group of six mature segments, three abnormalities were found. One segment had a genital pore, cirrus pouch, and transverse portion of the vagina duplicated on opposite sides of the segment. In this case the mass of coils of the vas deferens was also duplicated, but the two transverse vaginas met to form a single tube in the middle of the segment. In another segment two cirrus pouches, each with its accompanying coil of the vas deferens, lie one immediately behind the other on the same side of the segment, but only a single vagina, anterior to the first cirrus pouch, is present. In another segment the vagina opens posterior to the cirrus instead of anterior, as is the case in every other instance.

#### Family DILEPIDIDAE (?) Railliet and Henry, 1909

##### GLOSSOCERCUS, new collective group of tapeworm larvae

*Definition.*—Larval tapeworms consisting of two parts separated merely by a constriction: (1) Head and neck and (2) long, slender, tonguelike tail. Head provided with four suckers and armed rostellum. Posterior part of neck with an oval cavity with a ductlike extension passing into tail, where it continues as an ill-defined central cavity partially filled with loose parenchyma. A pair of excretory tubes become conspicuous in posterior part of neck and pass through whole length of tail, usually becoming markedly wider just behind neck. Scolex retractile into anterior part of neck. Strong muscle fibers pass from neck back into tail. Found free in body cavity of small fish. Probably larvae of tapeworms of family Dilepididae, parasitic in fish-eating birds.

## GLOSSOCERCUS CYPRINODONTIS, new species

## PLATE 10, FIGURES 1-5

*Specific diagnosis*.—Length of head and neck about 4 to 7 mm, according to state of contraction; of body 9.5 to 12.5 mm. Maximum diameter of scolex (pl. 10, fig. 4) about  $630\mu$ , of neck (when relaxed) about  $280\mu$  to  $300\mu$ , and of tail about 0.8 to 1.2 mm. Suckers oval, about  $175\mu$  long and  $155\mu$  wide. Rostellum very muscular, when retracted shaped like cone with rounded sides, about  $175\mu$  wide and about the same in depth. Hooks (pl. 10, fig. 5) in two rows of 10 hooks each, the larger ones  $180\mu$  long, with blade  $100\mu$  long; guard (or ventral root)  $55\mu$  measured from dorsal contour of hook to base, and with breadth of about  $25\mu$  across base; root shorter than blade with expanded proximal end about  $20\mu$  broad. Smaller hooks  $130\mu$  long, with more curvature than long hooks; guard  $42\mu$  from dorsal contour of hook to base, and with transverse breadth of about  $30\mu$  across base; root expanded at proximal end to transverse width of about  $20\mu$ . Oval cavity in posterior part of neck (pl. 10, fig. 3, A) about  $500\mu$  long and  $200\mu$  wide. Longitudinal muscles in well-defined bundles (pl. 10, fig. 3, B). Tail shaped like an elongated willow leaf, its broadest point shortly behind junction with neck, thence tapering to a rounded point at posterior end (pl. 10, fig. 1). Excretory tubes in tail are very conspicuous and may be over  $100\mu$  broad.

*Type host*.—*Cyprinodon variegatus*.

*Location*.—Body cavity.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39527; paratypes, no. 39528.

*Remarks*.—These worms, up to two or three in a host, were found in about 30 percent of a dense swarm of top minnows (*Cyprinodon variegatus*) in a pool on Galveston Island. No specimens were found in individuals of the same species taken in the upper part of Galveston Bay, but one young specimen was found in a *Fundulus heteroclitus* in the upper bay. The worms were found free in the body cavity of the fish, although in a few instances they were seen coiled up in a delicate membranous cyst, which burst as soon as touched. The worms are extremely active, and capable of contracting and stretching to a remarkable extent. So far as I have been able to find, no larvae in any way resembling this one have hitherto been described, although the *Gryporhynchus* larvae come nearest to them. The nature of the scolex suggests the probability of the adult belonging to a member of the Dilepididae, but no form with a scolex conforming with that of this species in details of structure has so far been described in fish-eating birds. The nearest approach is

*Dilepis kempfi* Southwell, 1921, from a cormorant in Assam. In this the hooks are similar, but the scolex and suckers are markedly smaller.

CYSTICERCOIDES MENIDIAE, new species

*Specific diagnosis.*—Small oval cysticercoids  $200\mu$  to  $300\mu$  long and  $150\mu$  to  $185\mu$  broad. Evaginated scolex about  $155\mu$  broad and  $135\mu$  long, with poorly defined suckers but provided with 20 (or 18?) hooks in a double row, the short hooks  $50\mu$  long, the long ones about  $70\mu$ .

*Host.*—*Menidia menidia*.

*Location.*—Intestinal wall and mesenteries.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39530.

*Remarks.*—A few of these small tapeworm cysts were obtained from a silversides along with specimens of the gasterostome *Rhipidocotyle transversale*. It is probably the larvae of an avian parasite of the family Dilepididae, but I have not been able to identify the hooks with those of any North American species.

## Class NEMATODA

### Family ASCARIDAE Cobbold, 1864

Subfamily ANISAKINAE Railliet and Henry, 1912 (emend. Baylis, 1920)

CONTRACAECUM COLLIERI, new species (= *C. MICROPAPILLATUM*?)

PLATE 10, FIGURES 6-8

*Specific diagnosis.*—Body reddish, robust, bluntly rounded at head end, conical at caudal end. Length 18 to 26 mm, with maximum diameter of  $600\mu$  to  $750\mu$ . Head without distinct lips, but truncated and with pair of slight liplike elevations, one of which bears boring tooth, which is not pointed but resembles a knoblike papilla. Shortly behind head body conspicuously annulated for distance of about  $200\mu$ , beyond which annulations (pl. 10, fig. 7) become indistinct. Diameter through posterior part of striated region about  $240\mu$  to  $250\mu$ . Esophagus 2 to 3 mm long with diameter of about  $75\mu$ , followed by appendix about  $450\mu$  to  $590\mu$  long. Anterior diverticulum of intestine 1.45 to 1.9 mm long. Anus  $180\mu$  to  $200\mu$  from posterior end of body.

*Type host.*—*Cyprinodon variegatus*.

*Location.*—Body cavity.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39531.

*Remarks.*—These relatively large worms are fairly common in *Cyprinodon variegatus* in Galveston Bay. Usually one but sometimes two specimens occur in a single host, and in one instance two of these and one of the huge *Agamonema immanis* described below were found in a single *Cyprinodon* not over 3 inches in length. Four specimens were found in the body cavity of one of two *Paralichthys lethostigmus* examined. Ten specimens freshly removed from infested *Cyprinodon* were fed to each of three domestic mallard ducks. When no eggs were found in the feces by the end of three weeks the ducks were killed and examined, but no trace of worms of the genus *Contracaecum* was found.

CONTRACAEUM ROBUSTUM, new species (=C. MICROCEPHALUM?)

PLATE 10, FIGURES 9, 10

*Specific diagnosis.*—Body blood-red, robust, tapering in anterior fourth, bluntly conical at posterior end. Length 20 to 26 mm, with maximum diameter of 1 mm. Head without distinct lips, but with conspicuous pointed boring tooth about  $30\mu$  in length. Just behind head cuticle conspicuously marked with annulations, which are very close together and end rather abruptly after about  $135\mu$  to  $150\mu$ . Diameter through posterior part of striated region about  $325\mu$  to  $350\mu$ . Esophagus about 3.5 mm long with diameter of about  $160\mu$ , followed by appendix about 1.12 to 1.15 mm long. Anterior diverticulum of intestine 2.6 to 2.9 mm long. Anus  $135\mu$  to  $150\mu$  from posterior tip. Caudal end of body indistinctly annulated and terminated by demarcated conical lobe.

*Type host.*—*Mugil cephalus*.

*Location.*—Embedded in kidneys.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39533.

*Remarks.*—This worm is common in mullets during the summer months and accounts for the popular reputation of mullets being "wormy." It is also fairly common in *Fundulus heteroclitus* in summer. It is a much stouter worm than *C. collieri*, more tapering anteriorly, is much less distinctly striated posteriorly, and has a different boring tooth, a longer and broader esophagus, a longer esophageal appendix, and a differently shaped tail.

Fourteen specimens freshly removed from infected mullets were fed to each of two domestic mallard ducks. The feces of the ducks were then examined for ova every other day for three weeks, with negative results. The ducks were then killed and examined, but no trace of worms of the genus *Contracaecum* was found.

The relation of these two species of *Contracaecum* to the adult species known from American fish-eating birds is uncertain until

successful infection experiments have been performed. I can find no reference in descriptions of *C. spiculigerum* to the deep striations in the neck region, which is a conspicuous feature of both the species described above, but these striations are mentioned by Cram (1927) in *C. microcephalum* of ducks and ciconiiform birds and in *C. micropapillatum* of pelicans, as well as in *C. multipapillatum* of South American ciconiiform birds and in *C. tricuspe* of similar birds in Asia and Africa. Cram considers *C. quadricuspe* Walton a synonym of *C. microcephalum*. In his description of *C. quadricuspe*, Walton (1923) mentions that the tail ends abruptly in a terminal spine, which is also a character of *C. tricuspe*, but it is neither mentioned nor figured by Geddoelst (1916) in his description of *Kathleena arcuata*, a species that Baylis and Daubney (1922) found to be identical with Rudolphi's *microcephalum*. *C. robustum* has a terminal papillalike structure such as Walton figures for his *C. quadricuspe*, but the esophageal appendix is longer than in Walton's *quadricuspe* and similar to the dimensions given for *microcephalum*. *C. collieri*, on the other hand, has no papilla at the end of the tail and has a much slenderer esophagus, shorter appendix, and shorter cecum, in which respects it suggests the possibility of its being the young of *C. micropapillatum*. As noted above, however, both species were fed to domestic mallard ducks without resulting infection.

AMPHICAECUM PARVUM, new species

PLATE 11, FIGURE 1

*Specific diagnosis*.—Body small and slender, 6.7 mm long, with maximum diameter of  $230\mu$ . Diameter fairly uniform for most of length of body, tapering in anterior fourth and more abruptly at tail end. No striations on cuticle. Head truncated,  $60\mu$  across at anterior end. No larval boring spine, but mouth flanked on each side by bladderlike structure, which may be forerunner of a lip. Esophagus about  $830\mu$  long, followed by a more or less spherical bulb about  $15\mu$  in diameter and a large hollow appendix 1.06 mm in length. Diameter of esophagus about  $56\mu$ , of appendix about  $80\mu$ . Intestinal cecum about  $300\mu$  long and  $60\mu$  in diameter. Anus  $135\mu$  from posterior end. Tail conical, ending in truncated papilla-like structure about  $10\mu$  in diameter.

*Type host*.—*Dorosoma cepedianum*.

*Location*.—Intestine.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39535; paratype, no. 39536.

*Remarks*.—In the possession of a posterior esophageal bulb instead of a ventricle and of a large hollow esophageal appendix, this

form obviously belongs to the genus *Amphicaecum*, which Walton erected in 1927 for some larval forms obtained by Leidy from the weakfish (*Cynoscion regalis*). Walton presents no measurements but gives a diagram of the digestive system of a 15 mm specimen. In this it is clear that the intestinal cecum and esophageal appendix are smaller relative to the esophagus than in my specimens, and the two are therefore believed to be specifically distinct.

**RHAPHIDASCARIS ANCHOVIELLAE, new species**

*Specific diagnosis.*—Females 4 to 6 mm long, with maximum diameter of  $160\mu$  to  $250\mu$ . Head truncated,  $60\mu$  to  $72\mu$  in diameter. Esophagus, in specimens 5 to 6 mm long, about  $600\mu$  to  $750\mu$  long and  $90\mu$  to  $100\mu$  broad, with a small bulblike posterior ventriculus from which springs a posterior flattened appendix  $310\mu$  to  $420\mu$  long and about  $25\mu$  in diameter dorsoventrally and about  $60\mu$  in diameter from side to side. Ventriculus about  $30\mu$  to  $50\mu$  long and  $90\mu$  broad. Vulva 1.2 to 1.5 mm from anterior end. Ovejector directed posteriorly, dividing into two posteriorly directed uteri about  $630\mu$  from vulva. Uteri loop forward, but not anterior to vulva, and then pursue a wavy course backward, ending near anus. Anus about  $240\mu$  to  $300\mu$  from posterior end. Tail bluntly conical, terminating in a spine.

Males about 4 to 5.8 mm long with diameter of about  $165\mu$  to  $235\mu$ . Esophagus  $410\mu$  to  $500\mu$  long and  $65\mu$  in diameter, with ventriculus  $30\mu$  long and  $50\mu$  broad, and posterior appendix  $240\mu$  to  $280\mu$  long. Reproductive tube extends anteriorly to about  $350\mu$  behind end of esophagus and pursues a wavy course posteriorly to cloaca, which is  $90\mu$  to  $120\mu$  from posterior end. Tail abruptly conical at tip and terminated by a spine.

Specimens in anchovy immature with reproductive tubes present, but without adult lips and without spicules in males.

*Host.*—*Anchoviella epsetus*.

*Location.*—Intestine.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39537; paratypes, no. 39538.

*Remarks.*—These immature worms correspond in the structure of the alimentary canal with members of the genus *Rhaphidascaris*. Their specific identity is uncertain, since they are immature, but until the adult stage can be obtained by infection experiments it seems advisable to designate this species by a new name, even though it may subsequently fall into synonymy.

A few specimens of a larval form probably identical with this species from the anchovy were found in *Menidia menidia*, and also in a

specimen of *Trichiurus lepturus*, along with the two forms of larval *Porrocaecum* described below. The specimens from *Trichiurus* are slightly larger than the *Rhaphidascaris* in the anchovy, with relatively shorter and stouter esophagus, but this might easily be accounted for by a slightly greater age. The specimens from *Trichiurus* (all females) are 6.4 to 7.2 mm long, with a maximum diameter of  $230\mu$  to  $255\mu$ . The esophagus is  $700\mu$  to  $735\mu$  long, with a diameter of  $110\mu$  to  $115\mu$ ; and the diverticulum is  $350\mu$  to  $375\mu$  long. The anus is about  $265\mu$  from the tip of the tail.

**PORROCAECUM TRICHIURI, new species**

*Specific diagnosis*.—Length 6.85 to 8.4 mm, with maximum diameter of  $135\mu$  to  $180\mu$ . Head  $65\mu$  in diameter; diameter at anus  $65\mu$ . Tail  $105\mu$  to  $130\mu$  long, conical, rounded at tip, and conspicuously striated, the striations about  $4\mu$  apart. Esophagus anterior to ventriculus  $875\mu$  to  $910\mu$  long with a maximum diameter of  $60\mu$  to  $65\mu$ ; ventriculus  $340\mu$  to  $415\mu$  long and  $90\mu$  in diameter. Intestinal diverticulum  $530\mu$  to  $680\mu$  long, with diameter of  $50\mu$  to  $60\mu$  at base, tapering to rounded point at distal end. Only larval forms found, with boring tooth present and no development of reproductive system. Enclosed in delicate sheaths.

*Type host*.—*Trichiurus lepturus*.

*Location*.—Mesenteries.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39539; paratypes, no. 39540.

**PORROCAECUM SECUNDUM, new species**

*Specific diagnosis*.—Length 8 mm, with maximum diameter of  $160\mu$ . Head  $65\mu$  in diameter; diameter at anus  $65\mu$ . Tail  $130\mu$  long, conical, rounded at tip, and conspicuously striated, the striations about  $4\mu$  apart. Esophagus anterior to ventriculus  $910\mu$  long, with maximum diameter of  $85\mu$ ; ventriculus  $820\mu$  long and  $110\mu$  in diameter. Intestinal diverticulum  $900\mu$  long, more bluntly rounded distally than in *P. trichiuri*. Only a single larva found, with boring tooth present and no development of reproductive system.

*Type host*.—*Trichiurus lepturus*.

*Location*.—Mesenteries.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39541.

*Remarks*.—This worm differs from the larval *P. trichiuri* in the greater length of the ventriculus (which in this species is nine-tenths the length of the anterior part of the esophagus, while in all of five specimens of *P. trichiuri* it is only about two-fifths as long) and in the larger size of the intestinal diverticulum.



## GOEZIA MINUTA, new species

## PLATE 11, FIGURES 2-4

*Specific diagnosis.*—Body 3.1 mm long, nearly cylindrical, bluntly rounded at head end, bluntly conical at caudal end, and slightly narrower at end of anterior third of length than either before or behind this region (pl. 11, fig. 2). Maximum diameter  $280\mu$ . Cuticle provided with rows of spines for entire length. Spines largest and rows farthest apart in second fourth of body length, where they are spaced as much as  $22\mu$  apart. Just behind head annulations only  $6\mu$  apart; in the middle esophageal region and again in third fourth of body length, about  $15\mu$  apart; much closer in posterior region. In anal region the spines minute and directed forward instead of backward. Lips provided with prominent lateral papillae. Diameter across lips  $110\mu$ . Body constricted behind lips to diameter of  $85\mu$ . Caudal appendage bluntly rounded, about  $28\mu$  long and  $13\mu$  broad (pl. 11, fig. 4). Esophagus  $360\mu$  long, cylindrical, about  $65\mu$  in diameter for two-thirds its length, then widening out to diameter of about  $90\mu$ . Esophageal appendix a long, narrow tube about  $850\mu$  in length (pl. 11, fig. 3). Anterior cecum of intestine about  $180\mu$  long and  $115\mu$  broad. Spicules approximately equal, about  $345\mu$  long. Cloaca about  $45\mu$  from posterior end, exclusive of caudal appendage.

*Host.*—*Bagre marina*.

*Location.*—Stomach.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39542.

*Remarks.*—Only a single specimen, a male, has been found. Four of the five species of *Goezia* hitherto described were described in the early days of parasitology, and the descriptions are entirely inadequate from a modern point of view. The only well-described species is *G. gavialidis* Maplestone, 1930, and only a single female of this form was found. It is by no means certain that the form here described is not identical with some of the earlier species, but it would not be possible to identify it with any one of them at present. It seems best for the present, therefore, even though the name may eventually fall into synonymy, to consider it a distinct species.

## Family CUCULLANIDAE Barreto, 1916

## DICHELYNE FASTIGATUS, new species

## PLATE 11, FIGURES 5-7

*Specific diagnosis.*—Small, fairly stout nematodes, with body tapering fairly evenly in both sexes from esophageal region to tail. Cuticle in cephalic region thickened to about  $30\mu$ . Female 4.6 mm

long, with maximum diameter, at posterior end of esophagus, of  $390\mu$ . Esophagus  $720\mu$  long, anterior portion about  $320\mu$  long. Diameter  $180\mu$  across expanded anterior end,  $78\mu$  at narrow neck, where anterior and posterior parts join,  $135\mu$  across bulb. Lips  $170\mu$  broad, with finely fluted rather than serrated margins, and three papillae. Intestinal diverticulum reaches to about junction of two parts of esophagus. Vulva situated 58 percent of body length from anterior end. Anus about  $180\mu$  from tip of tail. Tail conical, about  $56\mu$  broad at anus, terminated by spine, which, as pointed out by Van Cleave and Mueller in the case of *D. robusta*, apparently has the structure of a sensory papilla. About in middle of postanal region a pair of conspicuous lateral papillae. Male  $5.75$  mm long, with diameter of about  $380\mu$ . Esophagus  $675\mu$  long,  $136\mu$  broad at expanded anterior end,  $70\mu$  broad at neck, and  $100\mu$  broad through bulb. Cloaca  $135\mu$  from tip of tail, with conspicuous lips. Caudal papillae arranged much as in *D. cotylophora*. Four pairs of papillae postanal, three pairs adanal, and four pairs preanal. Most posterior pair of postanal papillae ventral near tip of tail, next pair dorsal, next pair lateral, and next pair ventral. Two pairs of adanal papillae large and ventral, situated on sides of genital prominence immediately in front of and behind cloacal passage; third pair small and situated laterally. First pair of preanal papillae situated close to anterior pair of adanal papillae, other three pairs spaced out roughly  $150\mu$ ,  $400\mu$ , and  $700\mu$  from cloaca. Ventral sucker practically absent, although its position is faintly indicated by slight flattening in curvature of body. Spicules about  $1$  mm long, tubular,  $30\mu$  broad near base, and about  $10\mu$  broad near tip. Tip beveled off like tip of a hypodermic needle. A well-developed troughlike gubernaculum present, about  $120\mu$  in length.

*Type host*.—*Sciaenops ocellatus*.

*Location*.—Intestine.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. 39543.

*Remarks*.—Only two individuals of this species were found, a male and a young female. The species closely resembles *D. cotylophora* (Ward and Magath, 1916) but differs in the absence of the ventral sucker, in the somewhat longer spicules, in the slightly different arrangement of the caudal papillae in the male, and in the considerably greater diameter of the body relative to the length. In the thickness of the body and absence of a sucker it resembles *D. robusta* (Van Cleave and Mueller, 1932), but differs from that form in the length of the spicules and arrangement of caudal papillae in the male. It differs from *D. fossor* Jagerskiöld, 1902, in its smaller size, shape of esophagus, presence of cloacal lips, form and

arrangement of papillae, and length of spicules. From *D. mauritanicus* (Gendre, 1927) it differs in body form and in the thickness of the cuticle. (For description see Törnquist, 1931.) Linton (1901) figured and briefly described a female cucullanid from *Paralichthys dentatus*, which is clearly a *Dichelyne*. In 1905 he reported parasites that he considered similar from *Sciaenops ocellatus*, *Paralichthys albiguttus*, *Leiostomus xanthurus*, and *Lophopsetta maculata*, and in 1907 from *Haemulon carbonarium* and *Neomaenis griseus*. In 1901 he described a male from *Fundulus heteroclitus* and figured the posterior end, which is provided with a sucker. Barreto (1922) put all these records and figures together and called the collection *Cucullanus lintoni*. Törnquist (1931) called attention to the improbability of a single species of cucullanid occurring in such a wide range of hosts. As remarked above, Linton's form from *Paralichthys dentatus* is clearly a *Dichelyne*, but there is no positive evidence that the other forms are, since no mention is made of the presence or absence of an intestinal diverticulum.

The measurements given by Linton for the form from *Sciaenops ocellatus* correspond fairly well with those of the species here described, and it is not unlikely that Linton actually had this species. His *Dichelyne* from the flounder is, however, distinctly different in shape of head and tail, position of vulva, and other details. His form from *Leiostomus xanthurus* differs in having the vulva anterior to the middle of the body but agrees in this respect with the form from *Haemulon carbonarium*. The figure of a female from *Neomaenis griseus*, on the other hand, shows the vulva well posterior, and the shape of the body shows this form to be distinctly different from the form from *Paralichthys* figured in 1901.

It seems evident to me that Linton's various records do not apply to a single species but probably to several. Barreto's "*Cucullanus lintoni*", therefore, must either be discarded as a *nomen nudum* or limited to some one of Linton's forms. Barreto reproduces the figures of the forms from *Haemulon* and *Neomaenis* from Linton's plates 2 and 3 (1907). Of these figures, Linton's figures 11 and 11a of plate 2 (Barreto's pl. 36, figs. 1, 3) show characters that are of taxonomic value and that would probably serve to identify the species. If Barreto's name "*lintoni*" is retained, therefore, it is suggested that it be limited to the form from *Neomaenis* represented in Linton's figures 11 and 11a and that forms from other hosts be ascribed to that species only when a restudy of Linton's specimens, or additional material, shows them to be conspecific. For Linton's form from *Paralichthys dentatus*, represented on his plate 7, figures 57-61 (1901) and referred to by him as "*Ascaris* (?) sp." on p. 481, the name *Dichelyne cylindricus* is suggested.

**DICHELYNE DIPLOCAECUM, new species**

*Specific diagnosis.*—Body short and thick, its widest point about one-third of body length from anterior end; head end bluntly rounded, posterior end tapering to pointed tail. Length of young female 4 mm, maximum diameter  $525\mu$ . Vulva posterior to middle of body length, dividing body about 11:9. Anus  $175\mu$  from posterior end. Tail conical, terminated by short conical spine,  $105\mu$  in diameter at anus. Cuticle finely striated,  $50\mu$  thick in middle esophageal region,  $35\mu$  thick throughout most of body. Nerve ring  $360\mu$  from anterior end. Excretory pore  $665\mu$  from anterior end. Esophagus  $800\mu$  long,  $145\mu$  broad just behind mouth, narrowing to  $75\mu$  about  $350\mu$  from anterior end, then club-shaped, with maximum diameter about  $120\mu$ . Intestine ribbon-shaped, with transverse axis much bent and folded, and with two flat folded anterior diverticula, one dorsal and one ventral, the former somewhat the larger, reaching nearly to nerve ring.

*Type host.*—*Ictalurus furcatus*.

*Location.*—Intestine.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39544.

*Remarks.*—Only two young females were found. This species differs from all other known members of the family Cucullanidae in having two intestinal diverticula. Törnquist (1931) erected a new genus *Cucullanellus* for a group of small spindle-shaped cucullanids, which differ from typical members of the genus *Dichelyne* in having a ventral instead of a dorsal diverticulum. The present species, with both a dorsal and a ventral diverticulum and a body form intermediate between that typical of *Dichelyne* and *Cucullanellus*, respectively, makes it appear unjustifiable to separate these two genera, and *Cucullanellus* is, therefore, reduced to the rank of a subgenus of *Dichelyne*.

**INCERTAE SEDIS****AGAMONEMA IMMANIS, new species****PLATE 11, FIGURES 11-13**

*Specific diagnosis.*—Very long, cylindrical, and blood-red except in esophageal region, which is whitish and clearly differentiated. Length 110 to 155 mm, with maximum diameter of about  $900\mu$ . Anterior end bluntly rounded, with no distinct lips, but with minute boring tooth. Vestibule about  $200\mu$  long. Esophagus 20 mm long, about  $200\mu$  broad at anterior end, gradually widening to nearly  $600\mu$ , where it almost fills space inside of body. Posterior end with chitinous rectum about 1 mm long,  $200\mu$  wide where it joins intestine, and about  $40\mu$  wide at anus, which is terminal (pl. 11, fig. 13).

*Type host.*—*Fundulus heteroclitus*.

*Location.*—Peritoneal cavity.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39545.

*Remarks.*—These relatively huge immature nematodes are fairly common, coiled up in the body cavities of both *Cyprinodon variegatus* and *Fundulus heteroclitus*, some of which are only about half as long as the worms. Usually one but occasionally two specimens occur in a single host.

AGAMONEMA VOMITOR, new species

PLATE 12, FIGURES 1-4

*Specific diagnosis.*—Length 7.3 to 9.6 mm, with diameter of  $165\mu$  to  $250\mu$ , uniform for most of length. Cuticle finely striated except on dorsal side of tail, where there are coarse corrugations. Head  $90\mu$  to  $110\mu$  in diameter, capable of partial retraction so that cuticle may form a slight collarette. Two lateral lips, each with a prominent median papilla (pl. 12, figs. 1, 2); breadth of lips  $32\mu$  to  $38\mu$ . Anus  $135\mu$  to  $175\mu$  from posterior end, the tail with minute knob-like termination (pl. 12, fig. 4), actually longer in small specimens, presumably males; esophagus 1.5 to 2.2 mm long, with diameter of  $65\mu$  to  $95\mu$ , not divided into two regions; entire membranous lining of esophagus peculiar in being torn loose and turned inside out, remaining attached to mouth, when living specimen is cleared in carbolic acid and exposed to pressure under cover glass (pl. 12, fig. 3); esophageal lining when so everted has diameter of  $45\mu$  in bulblike anterior expansion, then narrows to  $22\mu$ , and then gradually widens to about  $50\mu$ . Nerve ring  $160\mu$  to  $200\mu$  from anterior end. Excretory pore about  $100\mu$  to  $120\mu$  behind nerve ring. No trace of reproductive tubes present.

*Host.*—*Ictalurus furcatus*.

*Location.*—Stomach.

*Locality.*—Galveston Bay, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. no. 39547; paratypes, no. 39548.

*Remarks.*—Several dozens of these immature nematodes were found in the stomach of a specimen of *Ictalurus furcatus*, a catfish ordinarily found in fresh water. The relationships of the worm are doubtful, but the lips and general appearance suggest affinity with the Physolopteridae.

## Class ACANTHOCEPHALA

## Family NEOECHINORHYNCHIDAE Travassos, 1917

## ATACTORHYNCHUS, new genus

*Generic diagnosis.*—Body small, stout, ventrally curved, with greatest diameter behind middle. Proboscis very small, armed with about eight diagonally transverse rows of hooks, about eight in number in anterior rows, about twice as many and half as large in posterior rows, the arrangement strikingly irregular. Hooks U-shaped, with large rod-shaped roots and slender spines, only tips of which project through cuticle. Proboscis sac about twice as long as proboscis. Retractor muscles of proboscis sac attached behind middle of body. Lemnisci very long and large, extending about to middle of body, one containing one nucleus, the other two. Testes large, subglobular, contiguous; syncytial cement gland in contact with testes. Well-developed cement reservoir and seminal vesicle, the latter with two ducts.

*Type species.*—*Atactorhynchus verecundus*, new species.

*Remarks.*—The only other genera in the family Neoechinorhynchidae with more than four horizontal rows of hooks on the proboscis are *Tanaorhampus* Ward, 1918, and *Pandosentis* Van Cleave, 1920. *Tanaorhampus* has a large, elongate proboscis with 20 or more transverse rows of large hooks, and a body that is cylindrical or enlarged anteriorly, while *Pandosentis* has a short cylindrical proboscis with hooks that are not U-shaped but bent at right angles, remarkably short lemnisci, and short retractor muscles.

## ATACTORHYNCHUS VERECUNDUS, new species

## PLATE 12, FIGURES 5-7

*Specific diagnosis.*—Body robust, bluntly rounded posteriorly, tapering to small proboscis anteriorly, and with maximum diameter behind middle of body. Females up to 6.5 mm in length, with maximum diameter about 0.63 mm. Males up to 4.5 long, usually smaller, with maximum diameter of 0.6 mm or less. Proboscis very small, nearly cylindrical, but slightly expanded distally, about 0.15 mm long and 0.06 mm in diameter. Hooks arranged irregularly in about eight diagonally transverse rows, the first four or five of which, occupying anterior two-thirds of proboscis, with about eight hooks each; last two or three rows smaller and with more hooks, last row having about 16, which are about half the size of anterior hooks. Hooks U-shaped, with broad, bluntly rounded roots and slender sharp points, only tips of which project through cuticle.

Measured from top of bend both points and roots about  $18\mu$  to  $19\mu$  long in hooks at anterior end of proboscis and only  $9\mu$  to  $10\mu$  long in hooks of posterior row. Proboscis sac about twice length of proboscis. Retractor muscles of sac long and slender, attached posterior to middle of body, so anterior end of body can be, and frequently is, retracted. Lemnisci long, about half length of body, in males terminating at about anterior margin of anterior testis. Testes in posterior half of body, contiguous,  $300\mu$  to  $400\mu$  long and about two-thirds as wide. Syncytial cement gland just behind testes, sometimes smaller, sometimes larger, in size; number of nuclei not determined. Cement reservoir bag-shaped, just behind cement gland. Seminal vesicle rounded, dorsal to anterior end of cement reservoir, and connected with genital aperture by two ducts. Eggs in uterus of female  $27\mu$  to  $30\mu$  long and  $12\mu$  to  $13\mu$  broad.

*Host*.—*Cyprinodon variegatus*.

*Location*.—Intestine.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39549; paratypes, no. 39550.

*Remarks*.—This parasite was found in about 30 to 40 percent of the specimens of *Cyprinodon variegatus* taken in the upper parts of Galveston Bay in August and was present in fairly large numbers in some hosts. Eighteen specimens of this fish taken on Galveston Island early in March yielded only two female worms, one in each of two hosts.

## Family CENTRORHYNCHIDAE Van Cleave, 1916

### ARHYTHMORHYNCHUS DUOCINCTUS, new species

#### PLATE 12, FIGURES 8, 9

*Specific diagnosis*.—Salmon colored when living, body spindle-shaped, quite abruptly narrowed posteriorly, 3.2 to 4.2 mm in length, with maximum diameter of 0.77 to 1.05 mm. Proboscis spindle-shaped,  $685\mu$  to  $900\mu$  long,  $160\mu$  to  $200\mu$  in diameter anteriorly,  $285\mu$  to  $310\mu$  through bulged region,  $200\mu$  to  $240\mu$  at base. Proboscis hooks arranged in 18 or 19 longitudinal rows of 15 or 16 hooks each. Anterior hooks moderately slender, sharply bent at base, blade nearly straight,  $53\mu$  long and  $13\mu$  to  $15\mu$  in diameter; hooks on bulged area shorter and heavier, more evenly curved,  $47\mu$  long and  $19\mu$  in diameter; posterior hooks slenderer, gently curved,  $50\mu$  long and  $8\mu$  to  $10\mu$  in diameter. Neck unarmed, in form of truncated cone,  $360\mu$  to  $400\mu$  long. Anterior part of body with two bands or girdles with fine transverse striations, and armed with spines in fairly regular quincunxial arrangement; anterior band shortly behind neck, with

about five or seven transverse rows of 50 to 60 spines each; posterior band of 10 to 13 transverse rows of 80 to 90 spines each. Spines all about  $20\mu$  long. Anterior band  $150\mu$  to  $200\mu$  broad, posterior band  $180\mu$  to  $300\mu$  broad, separated by distance of about  $75\mu$  to  $150\mu$ . Proboscis sac very large, 1.45 to 1.75 mm long, with diameter of  $250\mu$  to  $300\mu$ . Lemnisci not recognizable. Testes just behind proboscis sac in posterior part of broad region of body, close together or separated by less than  $75\mu$ , with diameter of  $135\mu$  to  $145\mu$ . Cement glands four, long and slender, extending from testes to near posterior end of body (about 1 mm).

*Host*.—*Paralichthys lethostigmus*.

*Location*.—Body cavity.

*Locality*.—Galveston Bay, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 39551; paratypes, no. 39552.

*Remarks*.—One of two specimens of *Paralichthys lethostigmus* examined contained eight immature specimens of this worm, attached to the mesenteries. The worms are in all probability the young of a species that matures in a fish-eating bird. Another form of strikingly similar general appearance, *A. hispidus*, was described by Van Cleave (1925) from a Japanese frog; it has been suggested by Fukui (1929) that *A. fuscus* Harada, 1929, obtained from Japanese night herons, may be the adult of this form. More recently Dollfus (1929a) has described an *Arhythmorhynchus* (*A. siluricola*) from two African catfishes, but I have not had access to this paper. Witenberg (1932) has erected a new genus, *Southwellina*, with Van Cleave's *A. hispidus* as type. This genus is differentiated from *Arhythmorhynchus* by the spindle-shaped instead of cylindrical body and by having four instead of two cement glands. Since Van Cleave omits any reference to the cement glands in *A. hispidus*, Witenberg must either have re-examined Van Cleave's material or have accepted *A. fuscus* as a synonym of it. However, *A. fuscus* has the typical *Arhythmorhynchus* body form. I have seen no reference in the literature to the number of cement glands in members of the genus *Arhythmorhynchus* other than in *A. fuscus*, which has four. Lühe (1911) merely describes the cement glands as "ausserordentlich lang und dünn, fadenförmig", but his figure of *A. frassoni* suggests more than two glands. Van Cleave (1916) in a revision of the genus in which he describes two new species, repeatedly refers to the cement glands as long and slender but makes no mention of their number.

In my opinion the genus *Southwellina* cannot be considered valid in the present state of our knowledge of these forms; therefore the species here described, which would fit that genus perfectly, is



placed in the genus *Arhythmorhynchus*. It seems probable that the immature forms of *Arhythmorhynchus* found in the body cavities of their second intermediate hosts, frogs or fishes, differ from the adults in the relatively undeveloped condition of the posterior part of the body, which presumably elongates after the parasites have reached the intestines of their definitive hosts. The four cement glands of these young forms may possibly fuse into two when they elongate in the adults, but it is more probable that in the adult worms the attenuated glands, closely applied to each other, have not had their number accurately determined except in the case of *A. fuscus*. A similar error has been made in the case of *Gorgorhynchus medius* (see Chandler, 1934), and it would seem advisable to reinvestigate the number of the cement glands in the genera *Centrorhynchus* and *Prosthorhynchus*.

**GORGORHYNCHUS GIBBER** Chandler, 1934

This species was found for the first time in two of three specimens of the marine catfish (*Galeichthys felis*) at Bolivar Point near the entrance from the Gulf of Mexico into Galveston Bay. It is a form close to *Echinorhynchus medius* Linton, 1907, adults of which were found only in *Mycteroperca apua*, although encapsuled immature specimens were found among the viscera of a number of spiny-rayed fishes. Linton's species was transferred by me (1934) to a new genus *Gorgorhynchus*, of which the present species, *G. gibber*, was made the type.

**RHADINORHYNCHUS TENUICORNIS** Van Cleave, 1918

This species, which Linton has recorded from a large number of species of marine fishes, was found in about 75 percent of the croakers (*Micropogon undulatus*), in two of three "spots" (*Leiostomus xanthurus*), and in one thread-fin (*Polynemus octonemus*) taken in Dickinson Lake in the lower part of Galveston Bay, but it was not found in any of seven croakers or three spots taken in the upper reaches of the bay. I have published elsewhere (Chandler, 1934) a more complete description of this parasite than has hitherto been available.

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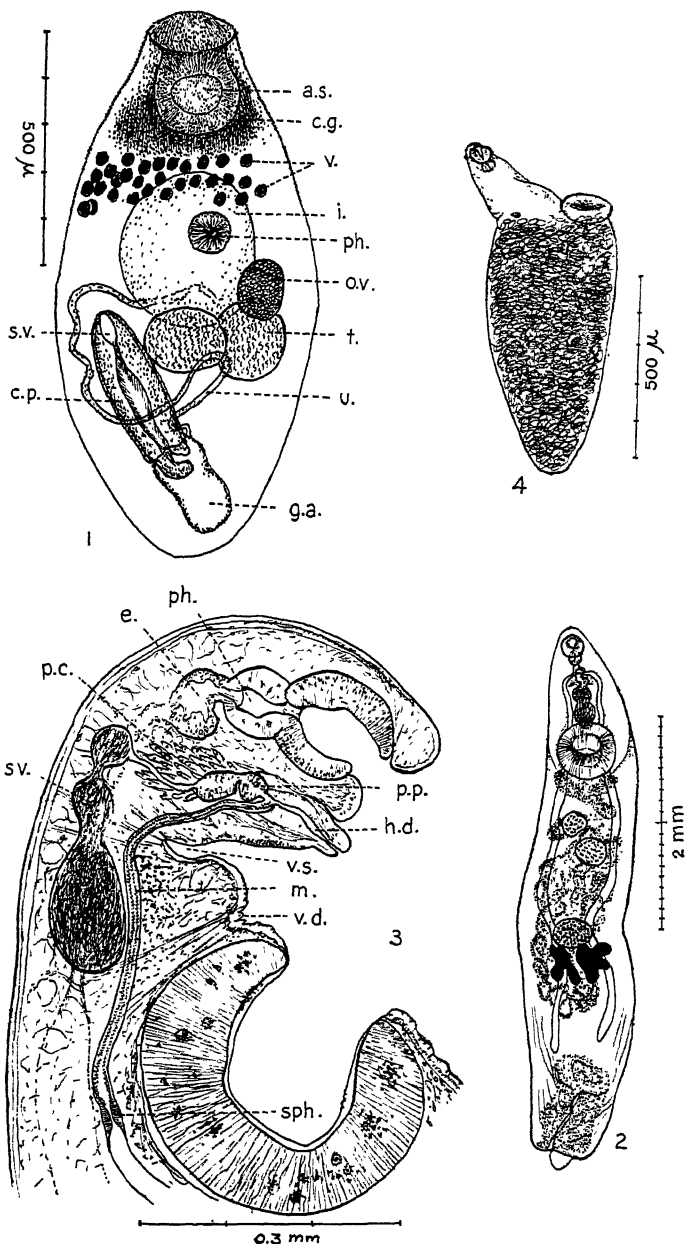
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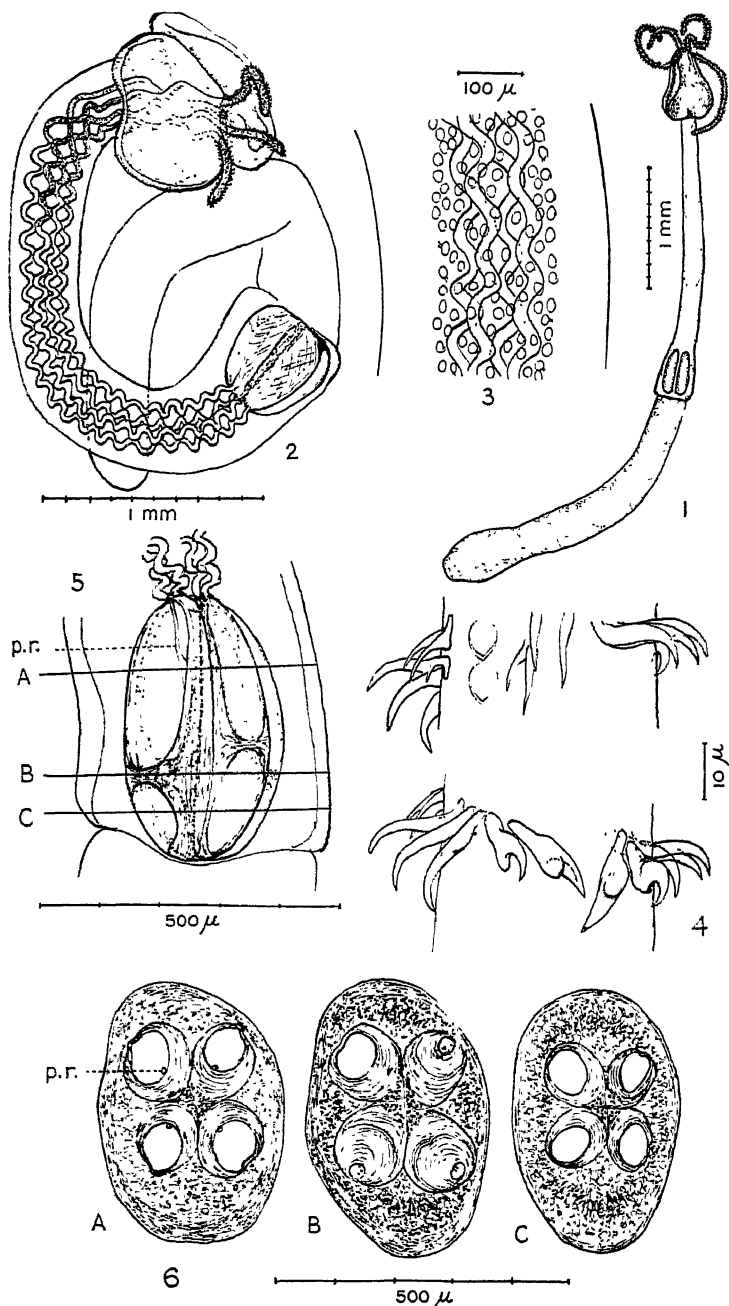
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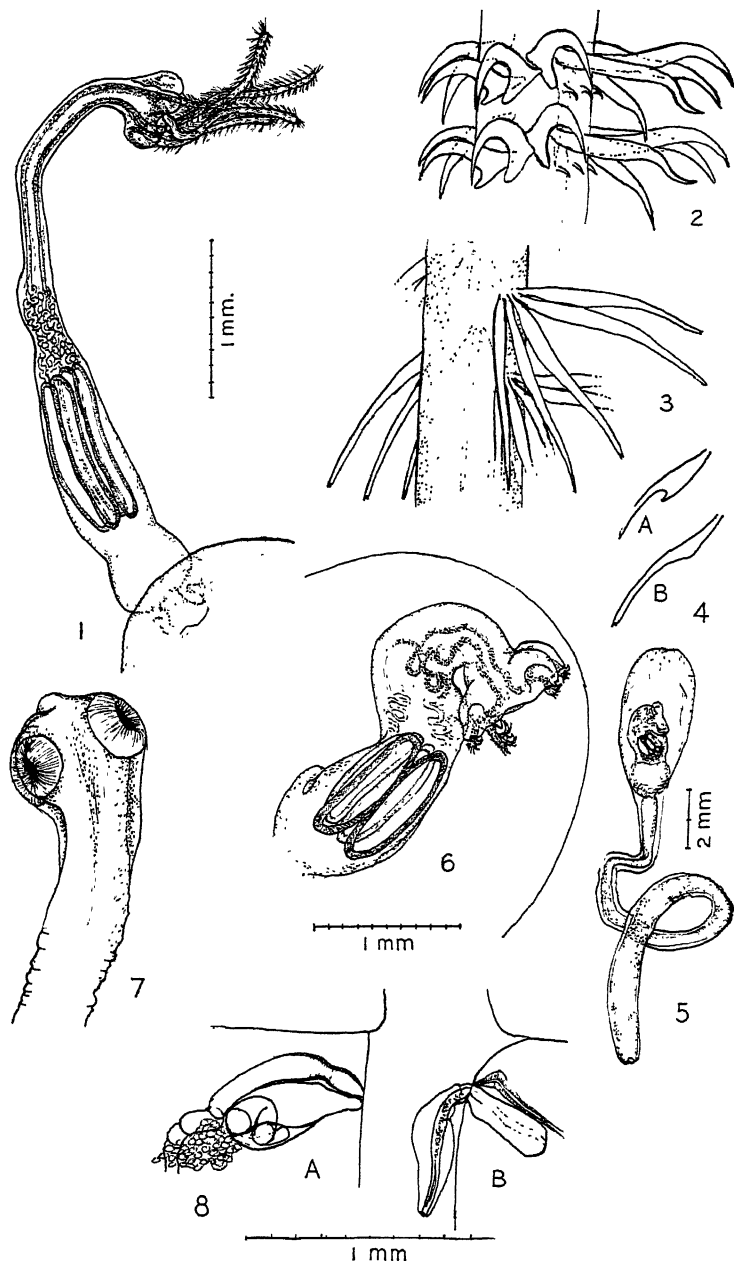
## PARASITES OF GALVESTON BAY FISHES.

1. *Rhipidocotyle transversale*. (a. s., Anterior sucker; c. g., cystogenous glands; g. a., genital atrium; i., intestinal sac; o. v., ovary; ph., pharynx; t., testis; u., developing uterus; r., vitellaria; s. r., seminal vesicle; c. p., cirrus pouch.)
- 2, 3. *Lecithochirium microstomum*: 2, Ventral view; 3, median longitudinal section through anterior end (e, esophagus; h. d., hermaphroditic duct; m., metraterm; p. c., prostate cells; ph., pharynx; p. p., prostatic part of vas deferens; sph., sphincter of metraterm; s. r., seminal vesicle; v. d., ventral depression; v. s., ventral sinus).
4. Unidentified distome from *Menidia menidia*.



## PARASITES OF GALVESTON BAY FISHES.

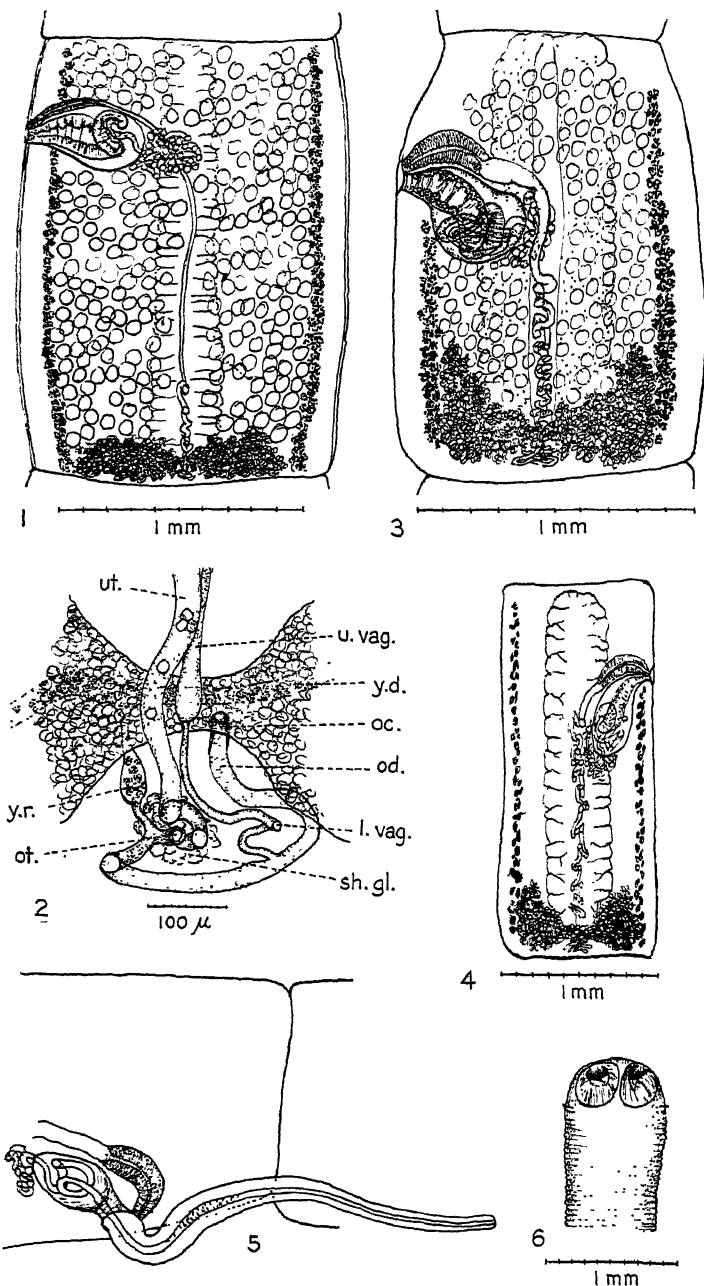
*Tentaculirina lepida*: 1. Removed from cyst; 2, enlarged to show course of proboscis sheaths; 3, portion of pars vaginalis, much enlarged to show granular bodies; 4, opposite views of one whorl of hooks on proboscis; 5, contractile bulbs (p. r., proboscis retractors); 6, cross sections through contractile bulbs at levels indicated by A, B, and C in figure 5.



## PARASITES OF GALVESTON BAY FISHES.

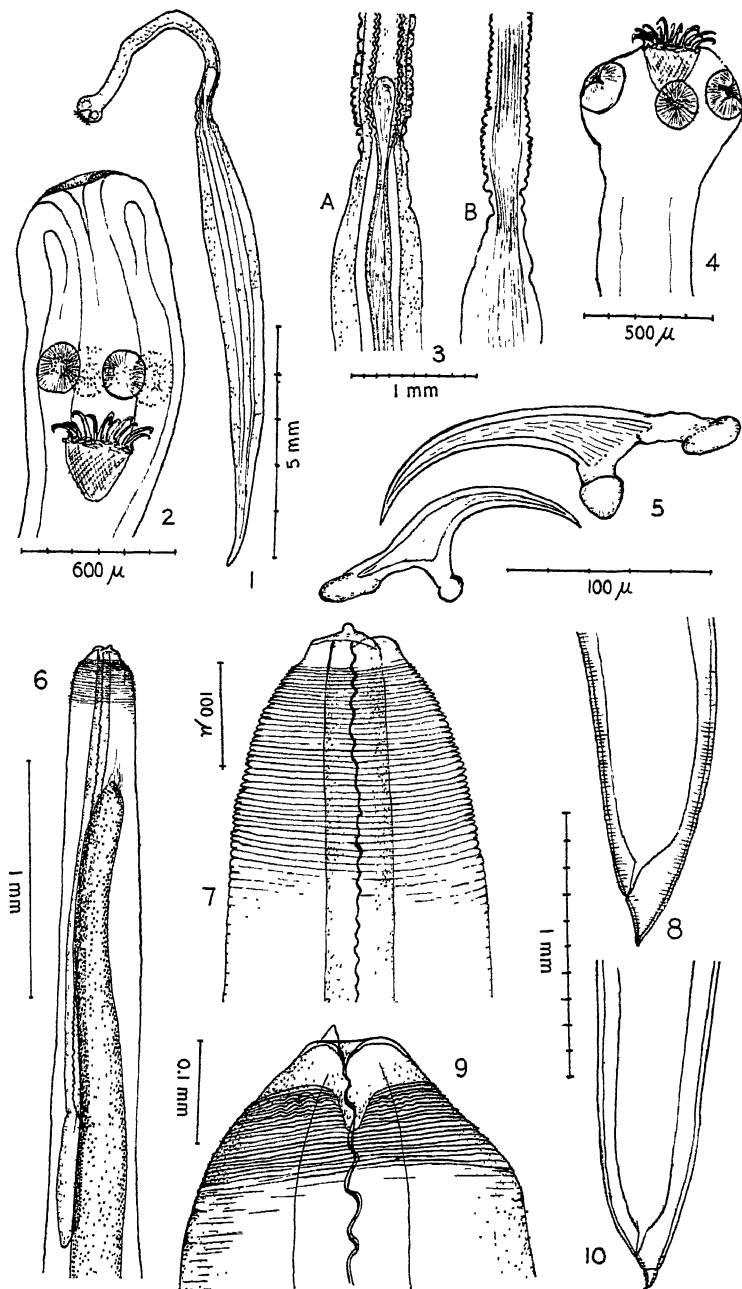
- 1-4. *Gymnorhynchus gigas*: 1, Head and neck, showing attachment to spherical vesicle of blastocyst; 2, portion of proboscis about 1 mm from base, showing two whorls of spines; 3, portion of proboscis about 0.75 mm from base, showing parts of two whorls of spines; 4, spines from near base of proboscis, A, two or three rows proximal to B.
- 5, 6. *G. malleus*: 5, Entire larva in cyst; 6, head and neck.
- 7, 8. *S. proteocephalus elongatus*: 7, Scolex; 8, A, vagina and cirrus pouch with cirrus retracted and vagina distended, and B, same with cirrus exerted and vagina not distended.





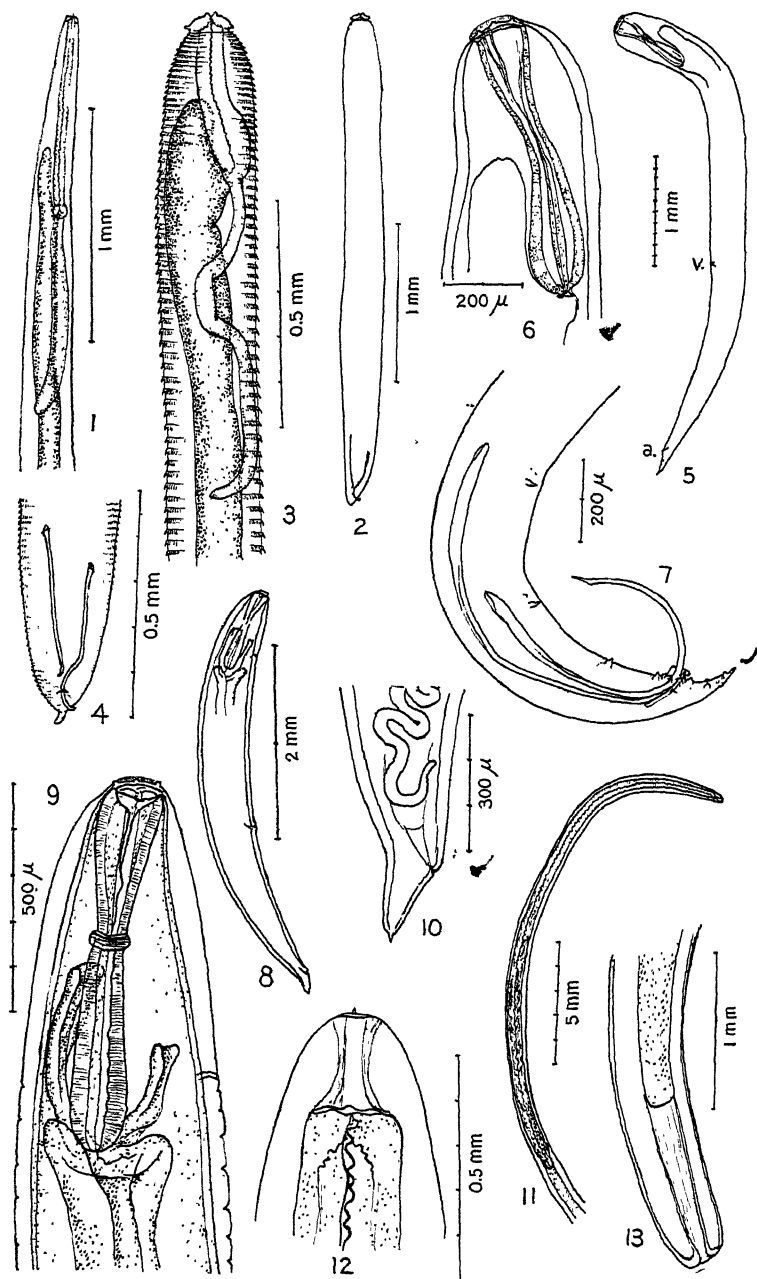
## PARASITES OF GALVESTON BAY FISHES

- 1,2. *Proteocephalus elongatus*: 1, Proglottid slightly past maturity; 2, female genital organs in posterior part of proglottid (*l. vag.*, lower vagina; *oc.*, oocapt; *od.*, oviduct; *ot.*, ootype; *sh. gl.*, shell gland; *ut.*, uterus; *u. vag.*, upper vagina; *y. d.*, yolk duct; *y. r.*, yolk reservoir).
- 3-6. *P. australis*: 3, Proglottid well past maturity; 4, ripe proglottid; 5, vagina and cirrus pouch, with cirrus exerted; 6, scolex.



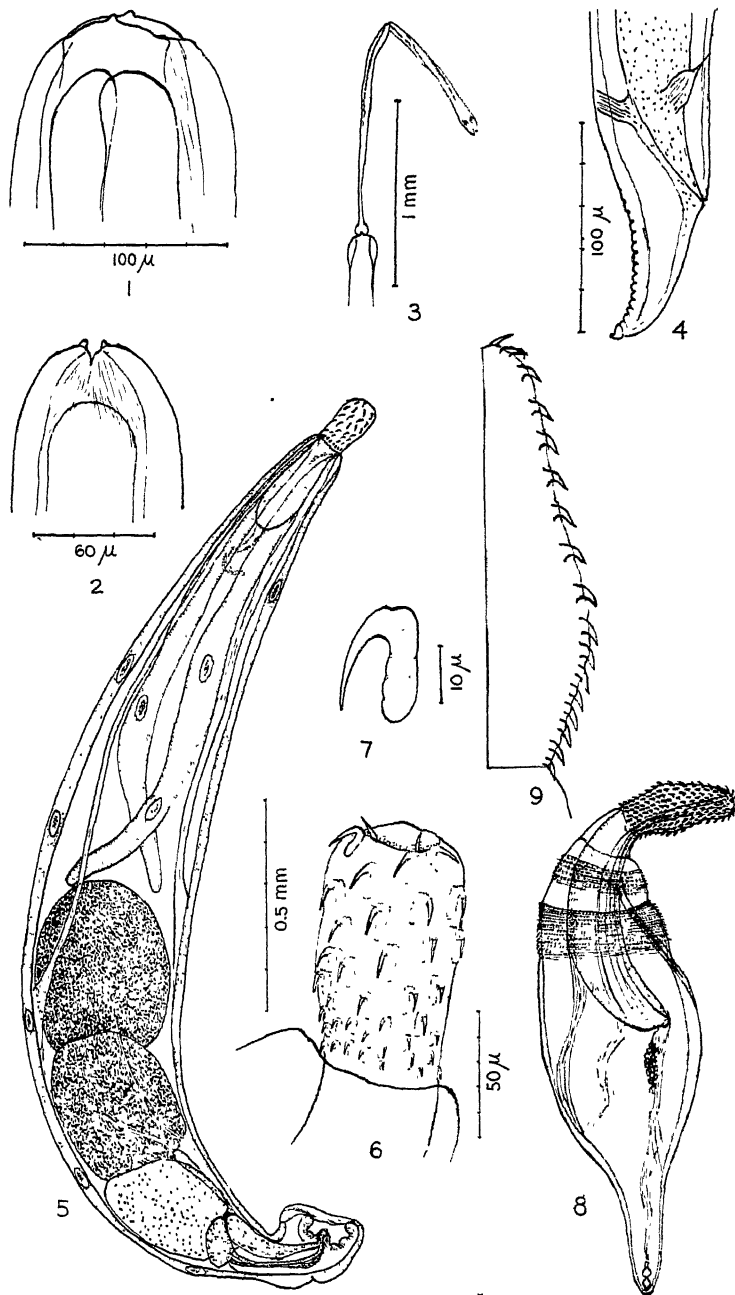
## PARASITES OF GALVESTON BAY FISHES.

- 1-5. *Glossocercus cyprinodontis*: 1, Entire specimen; 2, anterior end with scolex inverted; 3, neck region (A, median longitudinal section, showing cavity in neck and conspicuous excretory tubes; B, lateral longitudinal section, showing bands of muscle fibers); 4, scolex; 5, large and small hooks.
- 6-8. *Contracaecum collieri*: 6, Anterior end of body; 7, head; 8, posterior end of body.
- 9, 10. *C. robustum*: 9, Head; 10, posterior end of body.



## PARASITES OF GALVESTON BAY FISHES.

1. *Amphicaecum parvum*: Anterior end.  
 2-4. *Gozia minuta*: 2, Male; 3, male, anterior end; 4, male, posterior end.  
 5-7. *Dichelyne fastigatus*: 5, Female; 6, anterior end of male; 7, posterior end of male.  
 8-10. *D. diplocaecum*: 8, Young female; 9, anterior end; 10, posterior end of female.  
 11-13. *Agamonema immanis*: 11, Anterior end; 12, head; 13, posterior end.



## PARASITES OF GALVESTON BAY FISHES.

1-4. *Agamonea romitor*: 1, Head, dorsal view; 2, head, lateral view; 3, head, showing cuticular lining of esophagus everted from mouth; 4, posterior end.

5-7. *Atactorhynchus recurvatus*: 5, Male; 6, proboscis; 7, hook from anterior end of proboscis.

8, 9. *Arhythmorhynchus duocinctus*: 8, Immature female; 9, profile of proboscis.





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ON THE REPTILIA OF THE KIRTLAND FORMATION OF  
NEW MEXICO, WITH DESCRIPTIONS OF NEW SPECIES  
OF FOSSIL TURTLES

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THE PRESENT paper records the results of a study of a small collection of reptilian specimens in the United States National Museum from the Kirtland formation of New Mexico. It is a third contribution on this subject, as I have considered this fauna in two previous articles (Gilmore, 1916 and 1920). The materials were acquired (1) by a field party from the National Museum working under my direction, which spent the summer of 1929 collecting in the San Juan Basin; (2) by purchase of a small lot of turtles from C. H. Sternberg collected in 1923; and (3) by gifts from individuals or by transfer from the United States Geological Survey of a small but varied assortment of specimens. Study of these shows the presence of several new species of turtles, and other well-preserved specimens contribute to a better understanding of forms previously known.

The recovery of additional though incomplete dinosaurian specimens is of interest in showing the presence of forms other than those previously reported. It is proposed to review briefly those dinosaurian species that are now in other museums but that have been described since the appearance of my 1920 paper. Thus all the new information relating to the extinct vertebrate fauna of the Kirtland formation is brought together in this one article.

## DISCUSSION OF GENERA AND SPECIES

## Order DINOSAURIA

Since I reviewed the fauna of the Kirtland in 1920, notable advances have been made in our knowledge of the Dinosauria of this period. The discovery of well-preserved specimens has shown the presence of a new genus of the Ceratopsia, of which two species, *Pentaceratops sternbergii* Osborn and *P. fenestratus* Wiman, have been named. The presence of a chasmosaurid ceratopsian appears to be indicated by a fragmentary specimen. The genera *Ceratops* and *Monoclonius*, to which fragmentary specimens have previously been referred as occurring in this formation, should now be dropped from further consideration in that connection. Although it is quite evident that unrecognized ceratopsian genera are present here, better-preserved specimens are necessary before their affinities can be determined. At this time those specimens referred to *Ceratops* and *Monoclonius* have no significance except to indicate the presence of a ceratopsian with fenestrated frills. It is quite possible that some of the specimens so referred in the past may pertain to *Pentaceratops*. The family Hadrosauridae is represented by the two genera *Kritosaurus* and *Parasaurolophus*; the latter is of especial interest, as its first occurrence outside of the Belly River of Canada is now recorded.

The discovery of *Parasaurolophus*, *Gorgosaurus*, and a chasmosaurid dinosaur in the Kirtland formation known elsewhere only in the Belly River is strong evidence in support of the idea of the equivalence in age of these widely separated geological formations.

## Family DEINODONTIDAE

## GORGOSAURUS species

A specimen (U.S.N.M. no. 8346) collected by Dr. J. B. Reeside, Jr., in 1915, consisting of a left dentary, I described in a previous paper (Gilmore, 1916), but at that time I was unable to identify it. Comparison of this bone directly with a dentary of *Gorgosaurus libratus* Lambe from the Belly River of Canada now shows such close resemblances in size, shape, and other characteristics down to the smallest details as to leave little doubt of their being congeneric. Likewise, the number of alveoli (13) is in agreement with Lambe's (1917) determination from a number of specimens that the dentary in this genus bears 13 or 14 teeth.

## Family HADROSAURIDAE

## Subfamily HADROSAURINAE

## KRITOSAURUS NAVAJOVIUS Brown

Another occurrence of *Kritosaurus navajovius* is recorded by U.S.N.M. no. 8629, consisting of the posterior half of the skull, the left ramus, axis, and third and fourth cervical vertebrae. This specimen was collected by Dr. J. B. Reeside, Jr., in the Kirtland formation, 4 miles southwest of Kimbetoh, San Juan County, N. Mex., in 1916.

It is slightly smaller than the type of the species, but agrees closely with it except in one particular—none of the teeth of the dentary show papillae, but all have smooth borders. The precise number of tooth rows in the dentary cannot be determined from this specimen, although it shows them to be more than 40.

## Subfamily LAMBEOSAURINAE

## PARASAUROLOPHUS TUBICEN Wiman

## PLATE 13, FIGURE 1

The presence of crested hadrosaurians in the Kirtland formation was recognized by me in 1919 on meager materials, but the description of *Parasaurolophus tubicen* by Dr. Wiman (1931) is the first generic recognition of the Lambeosaurinae in these beds. The type specimen, now preserved in the Paleontological Institute of the University of Upsala, Sweden, consists of a partially disarticulated skull, with the posterior half of the characteristic overhanging crest formed by the frontals and premaxillaries, which leaves no uncertainty as to the proper assignment of this specimen. It was collected in San Juan County, N. Mex., in 1921, by C. H. Sternberg.

U.S.N.M. no. 13492, consisting of a posterior half of the right maxillary with teeth, left femur, posterior end of the left ilium, and the almost complete articulated tail, is, on account of the tall spinous processes on the anterior caudal vertebrae, provisionally referred to this same genus and species. This specimen was collected in T. 25 N., R. 13 W., about 6 miles north of Hunter's Store (Bisti P. O.), by N. H. Boss in 1929. The uncertainty of its reference is due to the incompleteness of the specimen on which the genus was established by Parks (1922), which had only the first four vertebrae of the tail present.

Since the National Museum specimen lacks the spinous processes of these particular vertebrae, little of value remains for direct com-



parison. Of the two hadrosaurian genera now known from this formation, *Kritosaurus* may be dismissed from consideration, as the spines on the anterior caudals of a larger individual (Parks, 1929) do not have the elongated proportions of *Parasaurolophus*. The only other possible assignment, so far as known at the present time, is that this tail might pertain to the genus *Hypacrosaurus*, but more diagnostic materials are required to establish such a suggestion. Furthermore, *Hypacrosaurus* is an Edmonton genus, although since it has been recognized in the Two Medicine formation of Montana, no good reason exists why it might not also be found to occur in the Kirtland formation.

The tail shown in plate 13, figure 1, was found articulated and is complete except for the possible loss of a vertebra or two at the distal termination. There are 68 caudal vertebrae present. These were in series with the posterior sacrals of which there are three centra preserved. The posterior end of the left ilium was retained in articulated position, as shown in plate 13, figure 1. All the vertebrae posterior to its hinder border are regarded as caudals. The spinous processes are largely missing on the first six caudals, and the chevrons on all anterior to the tenth. The first complete spine found on the eighth vertebra has a length of 481 mm (about 19 inches). The ninth is 479 mm, and as they become progressively shorter in a posterior direction, the presumption is that the missing anterior spines would progressively increase in length. Based on the progressive rate of change in the known spines it would be a conservative estimate that the first caudal spine would have a height of 516 mm (about 20 $\frac{1}{4}$  inches).

Parks gives the length of spines in the first four vertebrae of the type of *Parasaurolophus walkeri* as 415, 410, 400, and 390 mm, respectively. Thus the Kirtland specimen exceeds *P. walkeri* in spine development, although the femur of the latter is slightly longer, measuring 1,032 mm, as compared with 985 mm for the specimen under consideration.

The great dorsoventral depth of the tail is strikingly illustrated by a vertical measurement taken across the fourteenth vertebra. From spine top to chevron tip it measures 31 $\frac{1}{2}$  inches. The seventh caudal has a spine 375 mm and a centrum 69 mm long; the tenth vertebral centrum is 65 mm long.

There are transverse processes on the first 16 vertebrae, but these are so poorly preserved as to be unworthy of description. As the principal features of this series are clearly set forth in plate 13, figure 1, further description of the tail is unnecessary.

The posterior half of a right maxillary, partly filled with teeth, was found in the block carrying the sacral portion, and it is pre-

sumed to belong to this same individual. The teeth of the functional series are much worn and extend but little below the alveolar border on the internal side. They have smooth borders, with strong median carinae, and none shows evidence of being papillate. In the present state of our knowledge concerning the teeth of the Hadrosauridae, the dentition of this specimen gives no assistance in its identification, especially since the teeth of the contemporary forms have not as yet been adequately illustrated or described.

The left femur preserved with this specimen is in an excellent state of preservation, except for the loss of portions of the head. It is typically hadrosaurian and differs from the femur of *P. walkeri* in having the posterior extremity of the fourth trochanter precisely at mid length, whereas in *P. walkeri* it is well below the middle.

Although this specimen is provisionally referred to *P. tubicen*, it may eventually be found to belong to a form as yet unrecognized in the Kirtland formation.

### Family CERATOPSIDAE

#### PENTACERATOPS STERNBERGII Osborn

##### PLATE 13, FIGURE 2

The genus *Pentaceratops* was established by Professor Osborn (1923) on a well-preserved skull found by C. H. Sternberg in the Fruitland formation. In 1929, George F. Sternberg collected a nearly complete right squamosal (U.S.N.M. no. 12002) (see pl. 13, fig. 2) in SW.¼, T. 24 N., R. 13 W., San Juan County, N. Mex., from the Kirtland formation, which Lull (1933) identifies as pertaining to this species, thus recording the presence of *P. sternbergii* in the Kirtland formation. A second specimen (U.S.N.M. no. 12743), consisting of a supraorbital horn-core and parts of a squamosal from this same locality and formation, is quite certainly referable to *P. sternbergii*. The horn-core in size, shape, and curvature closely resembles that of the type specimen. The two other known specimens (Amer. Mus. Nat. Hist. nos. 1624 and 1625) are said to have come from the Fruitland formation.

#### PENTACERATOPS FENESTRATUS Wiman

This species was founded (Wiman, 1930) on a crushed but essentially complete skull, collected by C. H. Sternberg on the north branch of Meyers Creek, 1 mile south of Kimbetoh Wash, San Juan County, N. Mex., from the Kirtland formation. A single fenestra in the squamosal bones distinguishes it from *P. sternbergii* and apparently was the character that suggested the specific name. Lull is

inclined to regard this fenestra as pathologic. A second specimen, consisting of the lower jaw associated with the greater part of the skeleton from Meyers Creek, was also described by Wiman. This material is in the University of Upsala, Sweden.

CHASMOSAURUS species

A supraorbital horn-core (U.S.N.M. no. 12018), collected by N. H. Boss in the Kirtland formation, 5 miles west of Brimhall's Store, San Juan County, N. Mex., in 1929, is provisionally identified as pertaining to the genus *Chasmosaurus*. This identification rests on its close resemblance in form and size to the horn-cores of a skull of *C. belli*, described and figured by Lambe (1915). I am fully aware of the uncertainty of an identification based on such meager evidence, but with our present knowledge of the ceratopsian Dinosauria, the only other possibility is that this specimen might per-

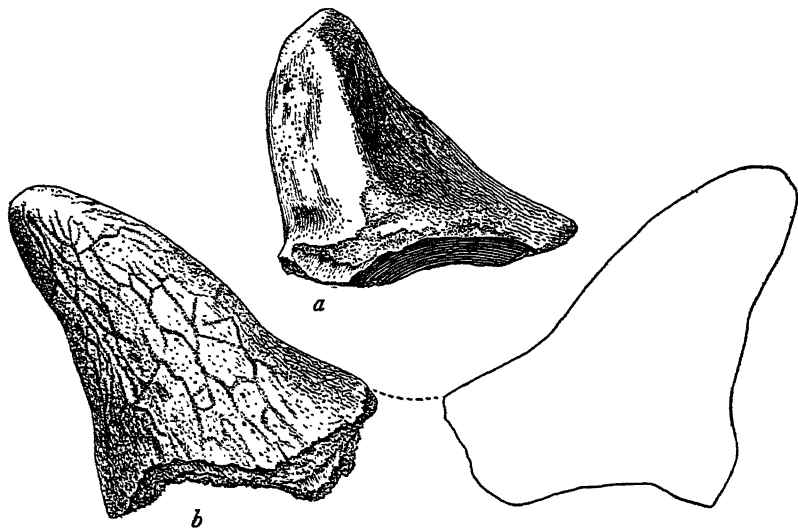


FIGURE 6.—Supraorbital horn-core of a chasmosaurid dinosaur, U.S.N.M. no. 12018: *a*, Lateral view; *b*, posterior view. A little less than one-third natural size.

tain to *Centrosaurus*, although in none of the skulls known to me of this genus do the supraorbital horn-cores closely resemble, except in size, the one before me. In either event the presence of a hitherto unrecognized ceratopsian genus in the Kirtland fauna is indicated.

This horn-core is short, with a bluntly pointed tip and slightly recurved. Broadly oval in cross section near the base with the greatest diameter anteroposteriorly, its broad ventral surface is hollowed and forms the upper boundary of the orbit. The surface of the horn is channelled by the usual series of ramifying canals. It is illustrated in figure 6.

## Order CHELONIA

Four families of Chelonia, the Pleurosternidae, Baenidae, Dermatemydidae, and Trionychidae, are now recognized in the Kirtland formation. Eleven species have been named, four of which are herein described as new.

### Family PLEUROSTERNIDAE

#### NEURANKYLUS BAUERI Gilmore

A single specimen (U.S.N.M. no. 13228), collected by the 1929 expedition, is referred to this species. It is considerably larger than the type specimen, the carapace measuring 605 mm in length on the median line, whereas the type is only 560 mm in this dimension. Except for its large size, the specimen contributes little to our knowledge of this species, as most of the sulci and all the sutures are obliterated. It was found by G. F. Sternberg in T. 23 N., R. 10 W., San Juan County, N. Mex., in the Kirtland formation.

Recently, however, Dr. Wiman (1933) has added much to a better understanding of the skeletal anatomy of this species, through the description of four specimens obtained for him in New Mexico in 1921 by C. H. Sternberg. The description of the cervical and caudal vertebrae and of the pelvic and pectoral arches together with a humerus gives the first information of the skeleton aside from the carapace and plastron. These species are said to have come from both the Kirtland and Fruitland formations.

### Family BAENIDAE

#### BAENA ORNATA, new species

FIGURES 7, 8; PLATE 14

*Type*.—U.S.N.M. no. 13229, consisting of a nearly perfect carapace and plastron. Collected by G. F. Sternberg, June 20, 1929.

*Locality*.—3 miles northeast of Hunter's Store (Bisti P. O.), SW $\frac{1}{4}$ , T. 24 N., R. 13 W., San Juan County, N. Mex.

*Horizon*.—Kirtland formation, Upper Cretaceous.

*Description*.—The specimen selected as the type of this species is an unusually well preserved carapace and plastron, lacking only some minor fragments. In outline the carapace is broadly ovate with scalloped borders posterior to the inguinal notches. There is a shallow median indenture in front and a wider and more pronounced emargination of the central posterior border.

At the widest part, about mid length, the carapace measures 437 mm across; its greatest length at the center is 478 mm. The depth

of the shell at the center, the highest point, is about 105 mm, probably more in life, since there is some indication of vertical compression.

The very rough surface ornamentation of the carapace (see pl. 14) is quite characteristic of this species, and this feature alone is sufficient to distinguish it from all described baenids with the possible exception of *Baena nodosa* Gilmore, which also occurs in this same formation.

The ornamentation consists of a series of elongate, longitudinal, round-topped ridges and low, rounded, nodelike protuberances.

These are arranged in alternate transverse bands across the mid region of the shell, extending somewhat outside of the vertebral areas, where they are sparser and less regular in their placement. In the type there is a median ridge formed by three and four of these elongated elevations set closely parallel with narrow grooves between. This ridge is not continuous but interrupted at intervals where the transverse bands of rounded

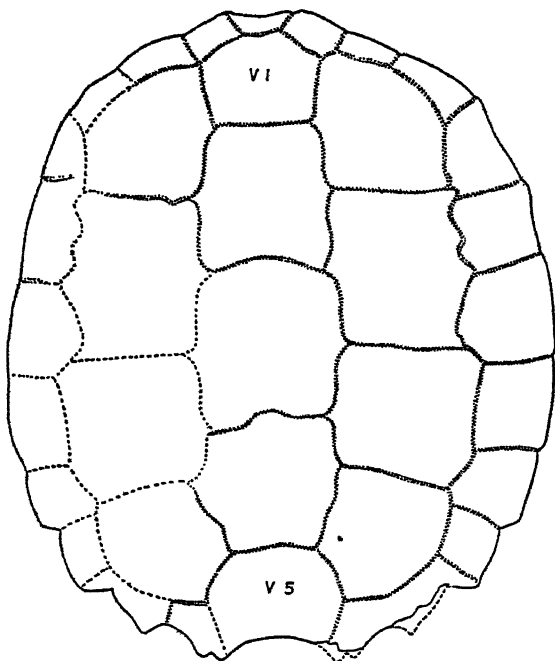


FIGURE 7.—Carapace of *Baena ornata*, new species. Type. U.S.N.M. no. 13229. V1, V5, Vertebrales 1 and 5, respectively. One-sixth natural size.

nodes cross from one side to the other. In U.S.N.M. no. 12821, which clearly pertains to this species, this ridge is made by a single elevation, although the other sculpture is quite similar to that of the type specimen. The outer half of the costal area and the whole posterior fourth of the shell have an undulating surface, but plain except for a few low scattered nodes. The surface is not smooth but slightly wrinkled, with a shagreened appearance resulting. The peripheral surfaces are fairly smooth, except along the front of the shell, where they are ornamented by low, irregularly shaped elevations.

TABLE 1.—Measurements of vertebral scutes of *Baena ornata*

No.	Length	Width
	<i>Mm</i>	<i>Mm</i>
1.....	68	96
2.....	103	111
3.....	115	127
4.....	106	122
5.....	72	110

The sulci are plainly impressed, except on the left side. The sutures, however, are entirely obliterated. The nuchal of the type is trapezoidal with the widest side anterior; in a second specimen (U.S.N.M. no. 12821) it is rectangular. It has a length of 14 mm and a greatest width on the free border of 50 mm.

The vertebral scutes are wider than long. Their principal dimensions are given in table 1. The shape of the carapace and the arrangement of the dermal scutes are clearly shown in figure 7.

The emargination on the posterior border is about 95 mm wide. The plastron is completely preserved, but as with the carapace none of the sutures can be traced, and the sulci on the

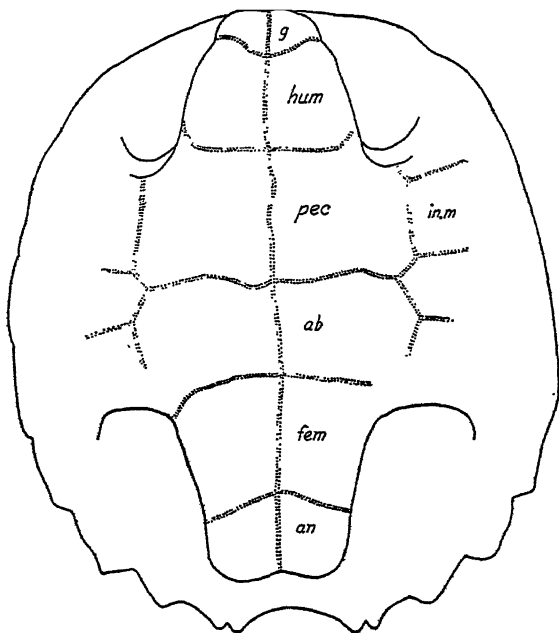


FIGURE 8.—Plastron of *Baena ornata*, new species. Type. U.S.N.M. no. 13229. *ab*, Abdominal; *an*, anal; *fem*, femoral; *g*, gular; *hum*, humeral; *in.m*, inframarginals; *pec*, pectoral scute. About one-sixth natural size.

outer parts of the bridge have been obliterated. The median part of the plastron is broadly hollowed out, indicating the male sex of the type specimen. The plastral surface is evenly sculptured by a series of shallow pits, surrounded by low, round-topped ridges. The pits are of irregular shape and size but present a fairly uniform rough-

ening of the entire surface. The plastron as a whole is large. The total length is 440 mm. The anterior lobe has a length of 117 mm and a breadth at its base of 150 mm. From the base the lateral borders run forward and inward, turning inward rather abruptly immediately preceding the junction of the gular-humeral scutes to form a slight notch, as shown in figure 8. The end of the plastron is truncated and is about even with the anterior border of the carapace.

The posterior lobe has a length of 120 mm and a width at the base of 155 mm, and ends forward of the posterior border of the carapace. The posterior end is angularly concave. The bridge has a width of about 205 mm.

Gular scutes are present, but I find no trace of intergulars. The gulars measure 35 mm in length on the mid line; the humerals 73 mm; the pectorals 106 mm; the abdominals 73 mm; the femorals 95 mm; and the anals about 60 mm.

On the bridge there are indications of four large inframarginals lying principally on the plastron bones.

As mentioned previously, the ornate sculpture of *Baena ornata* at once distinguishes this species from all described forms, with the possible exception of *B. nodosa*. From that species it may be distinguished by the more quadrangular form of the shell; greatest transverse diameter at mid length; quadrangular shape of first vertebral and the absence of accessory scutes lateral to the first vertebral; and in having all the vertebrae wider than long.

A second specimen (U.S.N.M. no. 11083) is also identified as belonging to this species. It is larger than the type specimen, and the plane surface of the plastron points to its being a female. This specimen was collected by C. H. Sternberg from the Kirtland formation in the "wash south of Ojo Alamo Wash," 9 miles northeast of Tsaya, San Juan County, N. Mex., in 1923.

The carapace except in front lacks most of its outer rim, but the plastron is complete except for a small portion of the posterior lobe. It has an estimated length of about 510 mm, which indicates the much larger size of this individual. as the plastron of the type measures only 440 mm. The anterior lobe is strongly notched at the junction of the gular-humeral scutes, as in the type. At this point it has a greatest transverse diameter of 93 mm. The lobe is 125 mm long and 183 mm wide at the base. The bridge is 245 mm wide. The posterior lobe is 195 mm wide at the base.

A third specimen (U.S.N.M. no. 12821) may also be clearly referred to this species. It was collected by me in SW $\frac{1}{4}$ , T. 24 N., R. 13 W., 3 miles northeast of Hunter's Store, San Juan County, N. Mex., in 1929.

## BAENA NODOSA Gilmore

Since *Baena nodosa* was first described in 1916, no less than eight specimens acquired by the National Museum have been identified as pertaining to this species. Four of these have been commented on previously (1920). Two were obtained from C. H. Sternberg, and the other two were collected by the 1929 paleontological expedition. All have the characteristic nodelike ornamentation of the carapace and in most respects are in accord with the type specimen. Two specimens (U.S.N.M. nos. 12819 and 11323) differ from the type in having a more broadly rounded anterior border of the carapace, and no. 11323 also has the nodes more sparsely placed over the surface of the shell. In all other respects these specimens show no discordant features. That the type is not a large example of the species is indicated by the length of the carapace at the center—375 mm, 380 mm, and 403 mm in three individuals—whereas in the type the length is only 354 mm.

U.S.N.M. no. 12819, collected by G. F. Sternberg 3 miles northeast of Hunter's Store, San Juan County, N. Mex., shows that the restored scallops along the rear border of the type specimen as illustrated in my original description are in error. Away from the central ones they become more rounded transversely with shallower indentations between them, instead of being bluntly pointed and having deep emarginations.

A nearly complete but somewhat crushed shell (U.S.N.M. no. 11327) is of interest in confirming the presence of this species in the Fruitland formation. It also records a new locality for the species—Coal Creek, 3 miles southeast of Tsaya, San Juan County, N. Mex.

In the collection made for the University of Upsala by C. H. Sternberg, Wiman (1933) found 17 specimens that he identified as pertaining to *Baena nodosa*. Eight of these are from the Kirtland formation, five from the Fruitland, and four are without designation as to horizon. Wiman calls attention to the great variation in the dermal scuta and in the form of the carapace. He finds none that are precisely in accord with the type of the species. Regardless of the differences found, he concludes that all should be referred to *B. nodosa*, a conclusion with which with one exception I am fully in accord. Specimen no. 9 of his series, in which he regards the lateral and marginal scutes as being wholly abnormal, may possibly pertain to the genus *Boremys*. If this suggestion is correct, it marks the first recorded occurrence of this genus in the Fruitland.

## Genus BOREMYS Lambe

The genus *Boremys* was established by Lambe in 1906 for the species *pulchra* previously referred by him to the genus *Baena*. In



1919 I added the species *B. albertensis*. Both of the type specimens were from the Belly River formation, Upper Cretaceous of Alberta, Canada. A specimen about to be described records the first occurrence of this genus outside of Canada.

Hay (1908) characterized the genus as follows:

Like *Baëna*, but having on each side supramarginal scutes, which alternate with the costal scutes. Nuchal bone short and wide. A preneural present.

I would amend this definition by the addition of the following characters: Five or six vertebrales, last vertebral separated from posterior border by supracaudal scutes. This is a character found among the Baenidae only in *Boremys* and *Thescelus*.

*Boremys pulchra*: Small size, front of shell broadly rounded; costal scutes wider than long. Five vertebral scutes.

*Boremys albertensis*: Small size, front of shell bluntly pointed; costal scutes longer than wide. Five vertebral scutes. Anterior lobe of plastron shorter than posterior lobe.

*Boremys grandis*: Large size, front of shell broadly rounded; costal scutes longer than wide. Six vertebral scutes. Anterior lobe of plastron longer than posterior lobe.

#### BOREMYS GRANDIS, new species

FIGURES 9, 10; PLATE 15

*Type*.—U.S.N.M. no. 12979, consisting of a nearly complete carapace and plastron. Collected by George F. Sternberg, 1929.

*Type locality*.—SW $\frac{1}{4}$ , T. 24 N., R. 13 W., 3 miles northeast of Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

*Horizon*.—Kirtland formation, Upper Cretaceous.

*Description*.—The specimen selected as the type lacks portions of the lateral borders and is somewhat depressed by vertical crushing. The shell is subquadrangular in outline, being longer than wide, with a broadly rounded anterior end and a truncated posterior border. Its large size at once distinguishes it from known species, as it is more than twice the size of *B. pulchra* and fully twice as large as *B. albertensis*. In this specimen the plastron projects strongly in front of the anterior border of the carapace, as in *Thescelus*; this feature, however, may be in part due to the crushing to which the specimen has been subjected.

The surface of the shell is undulating and is devoid of ornamentation, except for low-lying bosses that are sparsely scattered over the supramarginal and marginal areas. The central part of the carapace is fairly smooth, with slight indication of a median keel fore and aft.

The few anterior neurals that can be traced out have the same shape and relative proportions as those of *B. pulchra*. A preneural is present as in *Chisternon*. The form of these bones is well shown in figure 9. The costals are rather uniform in width so far as they can be determined.

The carapace has a greatest length at the center of 442 mm and a greatest width of 375 mm. The lateral borders posterior to the inguinal notches thin out to a sharp edge that is shallowly and widely scalloped.

The sulci outlining the various scutes are plainly impressed, but along either border, owing to faulty preservation, they can no longer be determined. The presence of supramarginal scutes is clearly shown on the forward half of the carapace (see fig. 9, *s.m.s.*), and the presence of these scutes at once determines the generic affinities of this specimen. There are large supernumerary costal scutes on each side of the first vertebral (fig. 9), as in the other species of the genus and often in

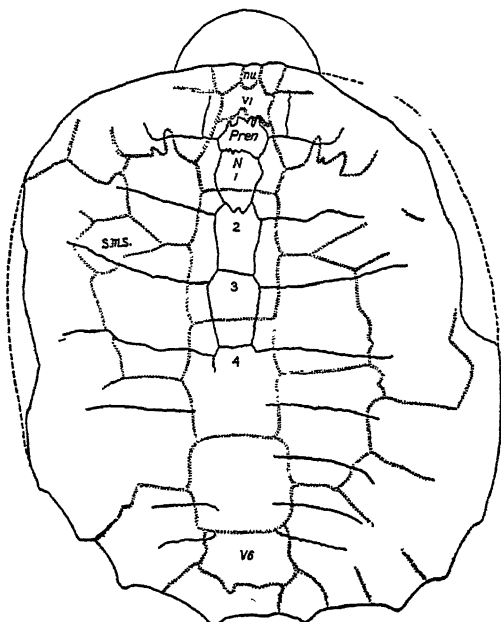


FIGURE 9.—Carapace of *Boremys grandis*. Type. U.S.N.M. no. 12979. N1, 2, 3, 4, Neurals 1 to 4; nu, nuchal scute; pren, preneural; s.m.s., supramarginal scute; V1 and V6, vertebrals 1 and 6, respectively. One-sixth natural size.

other members of the Baenidae. The supramarginal scutes form a row between the costals and the marginals and alternating with them. Although the full boundaries of the supramarginals have not been established, except in one instance, it is quite evident they have greater areal extent than in either of the described species, which has resulted in decreasing the size of the costal scutes. All the costal scutes are longer than broad, whereas in *B. pulchra* they are broader than long. Whether there was a supracostal scute present on the rear of the carapace, as in *B. pulchra* (Lambe, 1914, p. 14), cannot be determined in this specimen.

The nuchal scute is longer than wide, measuring 14 mm on the free border and 18 mm fore and aft. In both *B. pulchra* and *B. albertensis* this scute is much wider than long.

There are six vertebrals in the type, and since this number is present in a second specimen (U.S.N.M. no. 12978), it apparently indicates it to be a constant character of this species, as in *Baena hatcheri* and *Chisternon undatum*. This extra vertebral has not been found in either *B. pulchra* or *B. albertensis*.

The three anterior vertebral scutes are relatively narrow for a baenid. The first vertebral is shorter than broad, whereas in *B. pulchra* it is nearly twice as broad as long, and in *B. albertensis* these dimensions are subequal. The form of the scutes is clearly shown in figure 9, and their dimensions are given in table 2.

The sixth vertebral is excluded from the posterior border by the intervention of supracaudal scutes, as in *Thescelus*. These two genera are the only baenids in which this vertebral does not extend to the border.

The plastron has a length at the center of 398 mm and a greatest width of about 280 mm. The bridge has a width fore and aft of 188 mm. The anterior lobe is 116 mm long and 143 mm wide at the base. The width diminishes gradually toward the front, the end being broadly rounded. The posterior lobe is 98 mm long and 134 mm wide at the base. The borders rapidly converge as far back as the anal-femoral sulcus; from this point backward to the end the sides are nearly parallel. The posterior end is broadly but shallowly notched at the middle.

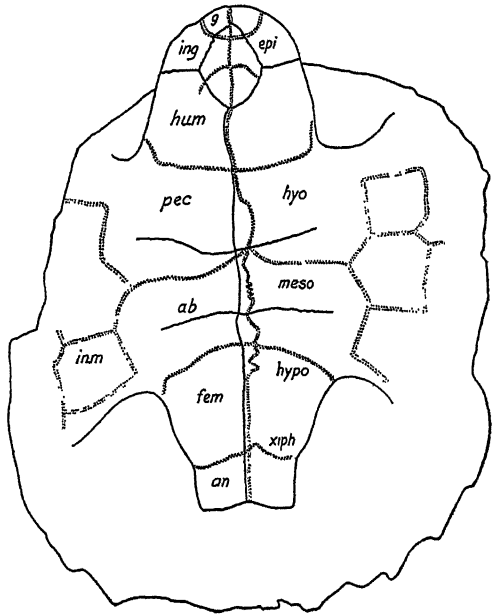


FIGURE 10.—Plastron of *Boremys grandis*. Type. U.S.N.M. no. 12979. *ab*, Abdominal scute; *an*, anal scute; *epi*, epiplastron; *fem*, femoral scute; *g*, gular; *hum*, humeral; *hyo*, hyoplastron; *hypo*, hypoplastron; *ing*, intergular scute; *inm*, intermarginal scute; *meso*, mesoplastron; *pec*, pectoral scute; *xiph*, xiphoplastron. One-sixth natural size.

TABLE 2.—*Comparative measurements of vertebrals of Boremys grandis*

No.	Length		Width	
	U.S.N.M. no. 12979 (type)	U.S.N.M. no. 12978	U.S.N.M. no. 12979 (type)	U.S.N.M. no. 12978
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	21	24	40	42
2.....	65	55	67	67
3.....	102	86	70	68
4.....	92+	90	78	71
5.....	82	74	85	86
6.....	46	-----	75	-----

The entoplastron is diamond-shaped, as in the other species of the genus (fig. 10). At the center the mesoplastrals meet on the mid line for 48 mm. These bones gradually widen from the center outward. The other sutures of the plastron are obliterated. The gulars meet on the median line for 26 mm; the intergulars for 23 mm; the humerals for 84 mm; the pectorals for 62 mm; the abdominals for 67 mm; the femorals for 90 mm; the anals for 45 mm.

There are four large inframarginal scutes on the bridge (fig. 10). *Boremys grandis* is at once distinguished from *B. pulchra* and *B. albertensis* by its much larger size and by the anterior lobe of the plastron being longer than the posterior. In the broadly rounded contour of the front of the carapace it resembles *B. pulchra* but is distinguished from *B. albertensis* with its pointed end.

Wiman (1933) briefly describes and figures a carapace from New Mexico, referred to *Baena nodosa*, which he says has the usual sculpture of that species but which has abnormal lateral and marginal scutes. The arrangement of these scutes strongly suggests the conditions found in the genus *Boremys* and indicates that perhaps this particular specimen may be a member of *Boremys*.

A second specimen (U.S.N.M. no. 12978), consisting of the right two-thirds of the carapace, and the plastron lacking the end of the posterior lobe, is also identified as pertaining to the present species. It was collected by N. H. Boss from the Kirtland in Brimhalls Wash, San Juan County, N. Mex., June 27, 1929. This specimen is slightly smaller than the type and displays some differences in the proportions of the scutal areas, but nothing more than might be expected in individual variations. In the general form of the carapace and plastron and in the character of the ornamentation of the carapace surface, the two specimens are in close accord.

Genus *THESCELUS* Hay

The genus *Thescelus* was established by Hay in 1908, and the species *T. insilens* from the Lance formation of Wyoming was selected as the genotype. At the same time a second species, *T. rapiens*, from the Ojo Alamo formation of New Mexico, was described. The genus was assigned to the family Baenidae. A specimen in the present collection records the second occurrence of *Thescelus* in the Kirtland formation, and since it displays characters distinguishing it from all described species, the name *T. hemispherica* is proposed for it.

The original characterization of the genus is no longer adequate, and I therefore propose the following amended diagnosis:

Front of carapace greatly shortened and excavated on the mid line. Carapace as wide or wider than long. Fifth vertebral excluded from posterior border by intervention of paired supracaudal scutes. Plastron extending strongly beyond the front border of the carapace; bridges broad, extending far forward. Buttresses feebly developed.

**THESCELUS HEMISPHERICA, new species**

FIGURES 11, 12; PLATE 16

*Type*.—U.S.N.M. no. 12818, consisting of the incomplete carapace and plastron. Collected by George F. Sternberg, 1929.

*Type locality*.—3 miles northeast of Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

*Horizon*.—Kirtland formation, Upper Cretaceous.

*Description*.—The type specimen is an old individual as indicated by the coalesced sutures, none of which is longer visible. Although much of the peripheral region of the posterior half of the shell is missing, a small section of the posterior rim is preserved, and it permits an accurate measurement of the total length at the center as being 361 mm. The greatest width at about the middle is 370 mm. Since the first peripherals extend 13 mm in front of the bottom of the median excavation above the neck, the total length of the carapace is 374 mm. Thus the relative proportions of the carapace are similar to those of *T. insilens* from the Lance formation.

The form of the carapace resembles the other species in being broad, not greatly elevated, and having a broad median excavation for the neck. It is evidently not narrowed behind as in *T. insilens*. The one figured by Wiman from which the missing parts were restored, as shown in figure 11, has a shallow median excavation for the tail. The plastron extends far forward of the line of the carapace but otherwise resembles those of species of *Baena*.

The surface of the carapace is undulating, and outside the vertebral areas it is ornamented by a series of low, round-topped bosses and ridges. These are without regular arrangement and rather sparsely placed. Vertebral areas except first and fifth are smooth, these two being slightly roughened by low-lying elevations of irregular shape and size. There is indication of a low median keel

along the middle of the carapace, which becomes more apparent toward the posterior end. (Pl. 16.)

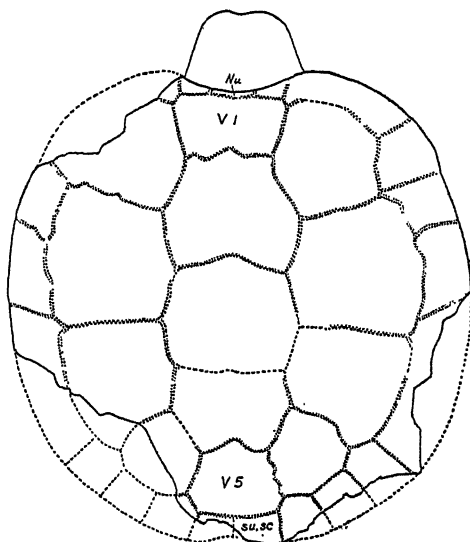


FIGURE 11.—Carapace of *Thescelus hemispherica*. Type, U.S.N.M. no. 12818, *nu*, Nuchal scute; *su.sc*, supracaudal scute; V1, V5, vertebrals 1 and 5, respectively. One-sixth natural size.

The scutal areas are distinctly marked on the shell and give the most complete information as to the arrangement of the scutes in this genus of any specimen yet obtained. The abbreviation of the front of the carapace has resulted in greatly reducing the size of the nuchal scute, which is very narrow anteroposteriorly, measuring 4 mm, whereas its width is 33 mm. This is the first time the presence of this scute has been recognized in this genus. Hay (1908, p. 96)

thought it to be absent in *T. insilens*, and this region was not preserved in the type of *T. rapiens*. U.S.N.M. no. 8074, from the Lance formation of Wyoming, which is referred to *T. insilens* Hay, distinctly shows a large nuchal present.

TABLE 3.—Comparative measurements of vertebrals of type specimens of two species of *Thescelus*

No.	Length		Width	
	<i>T. hemispherica</i>	<i>T. rapiens</i>	<i>T. hemispherica</i>	<i>T. rapiens</i>
	Mm	Mm	Mm	Mm
1.....	41	50+	92	82
2.....	75	75	113	92
3.....	87±	81	115	92
4.....	66±	61	99	92
5.....	52	-----	78	86

The first vertebral is much shortened, and all are wider than long. The form of the vertebrals is clearly shown in figure 11, and their principal dimensions are given in table 3.

The fifth vertebral does not come to the posterior edge of the shell, as in the other members of the Baenidae, but is separated from it by paired supracaudal scutes, as in *T. insilens*.

The total number of marginal scutes cannot be determined from this specimen.

The plastron is large. The axillary notch is forward, being only 35 mm from the front of the carapace. The opening for the head and fore legs is therefore much restricted. The front lobe extends

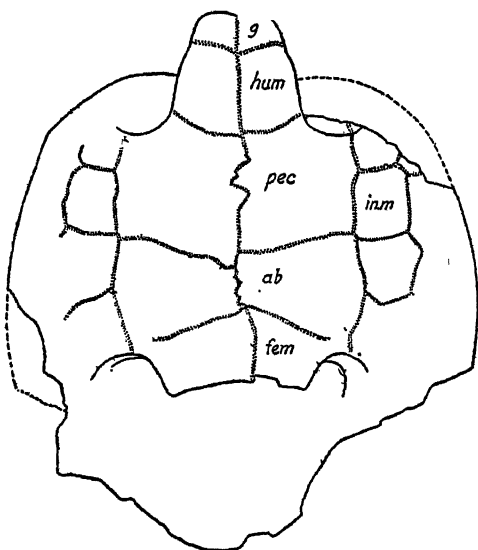


FIGURE 12.—Plastron of *Thescelus hemispherica*. Type. U.S.N.M. no. 12818. *ab*, Abdominal; *fem*, femoral; *g*, gular; *hum*, humeral; *inm*, inframarginals; *pec*, pectoral scute. One-sixth natural size.

well forward beyond the front of the carapace. The anterior lobe has a length of 89 mm and is shallowly excavated on the mid line. The base is 115 mm wide, but it narrows rapidly toward the front, so that at the gular sulci the width is only 74 mm. The posterior lobe at the base is 135 mm in width.

Anteroposteriorly the bridge has a width of 187 mm. From its inner end to the border of the carapace it is about 112 mm.

None of the sutures of the plastron is discernible.

The sulci are plainly impressed, and most of the

scutal areas are well defined, as shown in figure 12.

No trace of intergular scutes was found, although present in *Thescelus insilens* Hay. The gulars are large and meet on the mid line for a distance of 28 mm; the humerals for 61 mm; the pectorals for 94 mm; and the abdominals for 44 mm. On the bridge there are four inframarginals that have been satisfactorily determined. The median longitudinal sulcus runs a somewhat irregular course as in many other baenids.

This species is at once distinguished from the Lance *T. insilens* by the bosslike ornamentation of the carapace, the relatively wider vertebrals, posterior border of carapace without constrictions, and

in having the nuchal less deeply excavated; and from *T. rapiens* of the Ojo Alamo by the lack of a median depression along the back, relatively wider vertebrals, and rough sculpture of the carapace.

In a recent paper Wiman (1933) has described a specimen from the Kirtland formation of New Mexico, which he refers to *Thescelus insilens* Hay, a Lance species. Compared with the type of *T. insilens*, the broadly rounded posterior border of the carapace at once distinguishes it from the narrowed, protrudent border of the Lance specimen, and this feature in conjunction with their different geological occurrence apparently indicates the incorrectness of its assignment.

In so far as comparisons can be made from descriptions and illustration, I find the Upsala specimen to be in close accord with *T. hemispherica* here described, to which the specimen is now referred. In figure 11 the missing posterior borders of the type have been restored after the Upsala specimen, which fortunately is well preserved, and serve to give us a complete picture of the carapace. The one discordant feature of this assignment appears to be that of the surface sculpture, of which Wiman says: "Die Oberfläche zeigt heur und da eine feine wenig charakteristische Skulptur, die an gerunzeltes Chagrinleder erinnert." There is no trace of this style of sculpture on the shell of the type of *T. hemispherica*, but it has the sculpture of *T. insilens* as described by Hay (1908, p. 95).

Parks (1933a) recently described a new turtle under the name *Baena fluviatilis* from the Belly River formation of Canada, which at my suggestion is now referred (Parks, 1933b) to the genus *Thescelus*.

The presence of paired supracaudal scutes posterior to the fifth vertebral, rear border of carapace unscalloped, and anterior lobe of plastron longer than posterior are all features foreign to the genus *Baena* and in accord with *Thescelus*. Unfortunately much of the anterior border of the type specimen is missing, so that a full diagnosis cannot be made, but in view of the features pointed out the assignment to *Thescelus* is probably correct.

This specimen is of much interest in recording the first occurrence of *Thescelus* in the Belly River formation and also in greatly extending its known geographic range. *T. hemispherica* from the Kirtland may be distinguished from *T. fluviatilis* by its smaller size and relatively narrower vertebrals, especially the fourth and fifth, and narrower anterior lobe.



## Family DERMATEMYDIDAE

## BASILEMYS NOBILIS Hay

FIGURES 13, 14; PLATE 17

A complete but somewhat crushed specimen (U.S.N.M. no. 11084) records for the first time the presence of the genus *Basilemys* in the Kirtland formation. It was collected by C. H. Sternberg in

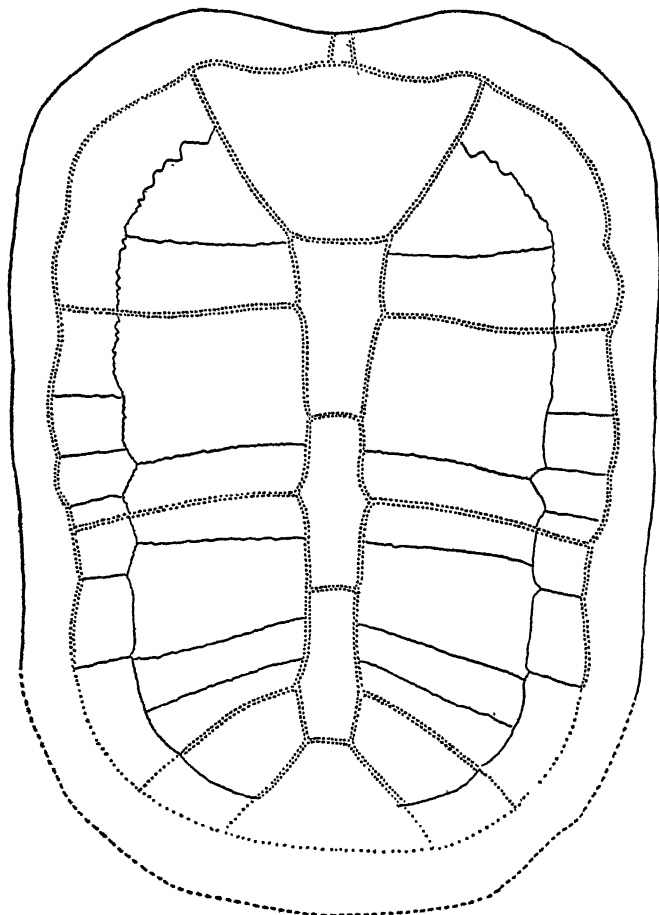


FIGURE 13.—Carapace of *Basilemys nobilis* Hay. U.S.N.M. no. 11084. One-sixth natural size.

1923 in Hunters Wash, 2 miles above Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

This specimen is provisionally identified as pertaining to *Basilemys nobilis* Hay (1911, pp. 316-317), the type of which is said to have come from the overlying Ojo Alamo formation. The fragmentary character of the type of *B. nobilis* makes it exceedingly

difficult if not impossible to identify certainly other specimens with it. In view of the similar geographic and near geologic occurrence of the two specimens and the close agreement in structural details, so far as comparisons are possible, the assignment of the specimen to *B. nobilis* seems justified. If correct in this tentative identifica-

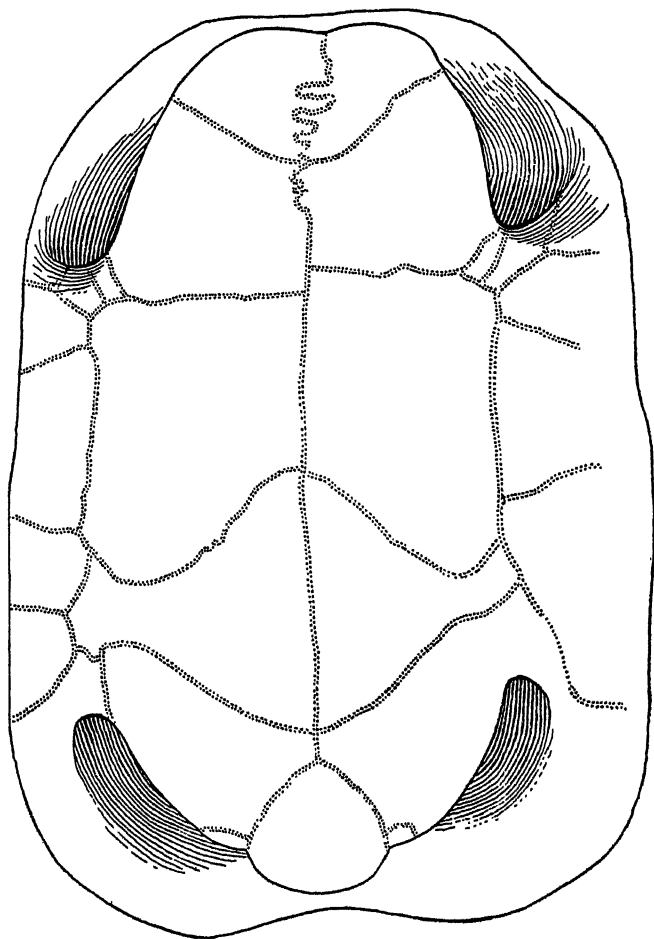


FIGURE 14.—Plastron of *Bastlemys nobilis* Hay. U.S.N.M. no. 11084. About one-sixth natural size.

tion, the specimen is of interest in contributing to a better understanding of this little-known species.

This specimen is about the same size as the type, the carapace at the center measuring 720 mm in length. The whole surface of the shell is sculptured with rough pyramidal elevations arranged in rows forming a pattern that is distinctive of the genus, but apparently alike in all described species.

The specimen is apparently an old individual, since most of the sutures are coalesced and the outlines of the individual elements can no longer be determined. The sulci outlining the dermal scutes can be traced and in most instances give a clear conception of their form and arrangement. The carapace has been badly crushed toward the right side, obscuring the width of the vertebrals (pl. 17).

The anterior border of the carapace is excavated above the neck, the free border at the center of the notch being about 48 mm thick. On each side of the mid line this border thins rapidly, soon forming an acute edge that thickens again before reaching the axillary notches. Behind the inguinal notches the border is slightly incomplete, but it was probably acute as in other species.

The nuchal scute is small, as in *B. sinuosa* Riggs, measuring 34 mm long and 16 mm wide. The vertebral scutes, except the first and fifth, are longer than wide, as shown in table 4.

TABLE 4.—Measurements of vertebrals of *Basilemys nobilis*

No.	Length	Width
	<i>Mm</i>	<i>Mm</i>
1.....	158	188
2.....	133	-----
3.....	135	-----
4.....	138	-----
5.....	137	201

The costal scutes are of large size. The second has a length longitudinally of 145 mm and a height of 303 mm. They extend far below the costoperipheral suture.

The plastron is excellently preserved and at the center has a greatest length of 700 mm. The sulci although relatively shallow are all clearly defined, and the form and proportions of the scutal areas have been certainly determined, as shown in figure 14. The sutures as on the carapace are obliterated. The bridge of the plastron measures 360 mm in width anteroposteriorly. The lobes are relatively short. The anterior lobe is 318 mm wide at the base and 152 mm long. Its sides turn in gradually toward the median line as far as the gular-intergular sulcus, from which it projects forward from the rest of the curvature of the lobe, forming a wide, prominently projecting, epiplastral beak much as in *B. praeclara* Hay. At the base this beak has a greatest width of 133 mm. The greatest thickness is 59 mm.

The posterior lobe is about 118 mm long and 310 mm wide at the base. The lobe appears to have been broadly rounded behind, as in *B. variolosa*.

The gular scutes are greatly reduced in size and are widely separated by a pair of large intergulars, which meet on the median line for a distance of 100 mm. In the presence of greatly reduced gulars this species resembles *B. variolosa*. The humeropectoral sulcus is at first directed backward from the axillary notch for 45 mm, then turns abruptly forward and inward to the median line. The humeral scutes at the center measure 23 mm in length. The pectoral scutes are narrow at their outer ends, as in *B. variolosa*. At the narrowest part they measure 43 mm, at the center 208 mm. The abdominal scutes are large, measuring 143 mm along the mid line; the femorals 100 mm, and the anals 117 mm.

The scutes covering the bridge are separated from the plastral scutes by a nearly straight sulcus running from the axillary to the inguinal notch. As pointed out by Hay (1911) only the most anterior and most posterior are inframarginals, the intervening ones being marginals. The absence of inframarginals constitutes one of the important distinctive features of the genus *Basilemys*.

In size and form of the carapace and in the proportions of the dermal scutes, this species has its nearest resemblances in *B. variolosa*. The chief distinction lies in the form and development of the epiplastral beak. It differs in being broad and protruding, instead of roundly pointed and nonprotrudent, as in *B. variolosa*. From *B. sinuosa* and *B. praeclara* it is distinguished by the greatly reduced gulars that are not in contact on the median line.

A specimen recently described by Wiman (1933, pp. 25-30) from the Fruitland shales of New Mexico is likewise referred to this species. The form of the anterior lobe has the shape of *B. variolosa* Cope, which differs considerably from the lobe of the Kirtland specimens previously described. If these two specimens pertain to the same species, the difference observed may be sexual, in which event the National Museum specimen is probably the male, the Upsala specimen the female.

#### ADOCUS BOSSI Gilmore

Four additional specimens pertaining to *Adocus bossi* were obtained by the 1929 expedition. These (U.S.N.M. nos. 12838, 12842, 12982, and 12983) are nearly complete shells and except for being flattened are in a good state of preservation. All were found close together in SW $\frac{1}{4}$ , T. 24 N., R. 13 W., San Juan County, N. Mex. A fifth specimen (U.S.N.M. no. 11326), which appears to be referable to this species, was collected by C. H. Sternberg in 1923 on Meyers Creek, San Juan County, N. Mex., from the Fruitland formation.

## Family TRIONYCHIDAE

*ASPIDERETES OVATUS*, new species

FIGURE 15; PLATE 18, FIGURE 1

*Type*.—U.S.N.M. no. 12986, consisting of the carapace lacking a portion of the anterior border and fragmentary parts of the plastron. Collected by C. W. Sternberg, 1929.

*Type locality*.—7 miles northwest of Brimhall's Store, San Juan County, N. Mex.

*Horizon*.—Kirtland formation, Upper Cretaceous.

*Description*.—The specimen selected as the type lacks the nuchal and portions of the right first costal, but otherwise, although much

checked and slightly distorted, the carapace is quite complete.

The carapace is oval, with the broader end forward of the middle. The rear end is broadly pointed. The shell has a greatest estimated length of about 310 mm and a greatest width of 283 mm.

The sculpture of the carapace consists of shallow, rounded pits, separated by ridges whose summits are flat topped. Toward the outer margins of the shell the pits tend to arrange themselves in

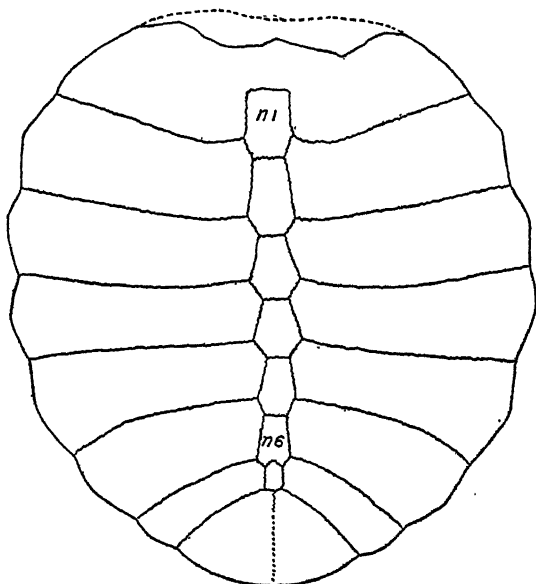


FIGURE 15.—Carapace of *Aspideretes ovatus*. Type. U.S.N.M. no. 12986. N1, N6, Neurals 1 and 6, respectively. One-fourth natural size.

rows parallel with the adjacent border (pl. 18, fig. 1). In the central area the pits are irregular in placement and less deeply impressed. A second specimen (U.S.N.M. no. 12987), which may be referred to this species, shows the central area to be smooth and almost devoid of pitting. There are a few spots on the central part of the type, showing a similar condition. A narrow band crossing the outer ends of the costals is free of pitting, as are the beveled ends. The sculpturing is distinctive and will serve at once to distinguish this species from the other Upper Cretaceous trionychids of this region.

There are seven neurals of the usual coffin shape, the seventh being much reduced in size, subelliptical in form. Table 5 gives the dimensions of these bones. The preneural cannot be differentiated.

TABLE 5.—*Measurements of neurals of Aspideretes ovatus*

No.	Length	Width
	<i>Mm</i>	<i>Mm</i>
1.....	38.5	<sup>1</sup> 26
2.....	36	26
3.....	32	25
4.....	30	23
5.....	27	18
6.....	24	16
7.....	14.5	9.5

<sup>1</sup> Estimated.

The nuchal is missing, but it quite evidently protruded prominently from the front border. The form of the costals is well shown in figure 15. The eighth pair of costals meet on the median line. It is also possible that the seventh pair may meet on the median line for a portion of their width.

In the ovate form of the carapace this species has a resemblance to *Aspideretes vegetus* but is distinguished by differences in the sculpture and presence in the latter of numerous longitudinal welts on the carapace.

#### ASPIDERETES VORAX Hay

FIGURE 16; PLATE 18, FIGURE 2

A specimen (U.S.N.M. no. 12988) consisting of the anterior third of the carapace is identified as belonging to *Aspideretes vorax* Hay. The assignment of any specimen to this species must to a certain extent be provisional because of the scanty nature of the type, which consists of a nuchal and costal fragments. The close resemblances in size and form of the present nuchal to that of the type, however, seem to leave little chance of their not being conspecific. If this assignment is correct, this specimen is of no little interest in contributing to a better understanding of this little-known species.

The specimen was collected by G. F. Sternberg from the Kirtland formation, 3 miles northeast of Hunter's Store (Bisti P. O.), SW $\frac{1}{4}$ , T. 24 N., R. 13 W., San Juan County, N. Mex., in 1929.

U.S.N.M. no. 12988 consists of the almost complete anterior third of the carapace anterior to the suture for the fourth costal. The front of the carapace is quadrangular, slightly excavated, and curved upward over the neck. The nuchal projects but slightly beyond the

forward margin. It measures 204 mm from end to end in a straight line and 210 mm over the curve. The same dimensions of the type nuchal are 200 and 215 mm, respectively. The width at the mid line is 45 mm, the same as in the type. Its greatest thickness is 14.5 mm, whereas the type has a thickness of 15 mm. The anterior border is steeply beveled to a sharp edge; this beveled surface without sculpturing is traversed by a faint median sinus. The posterior border is hollowed out at the center for the articulation of the preneural. This excavation has a width of about 38 mm.

This turtle is a large one, having a transverse diameter at the suture between the third and fourth costals of 482 mm. The outer

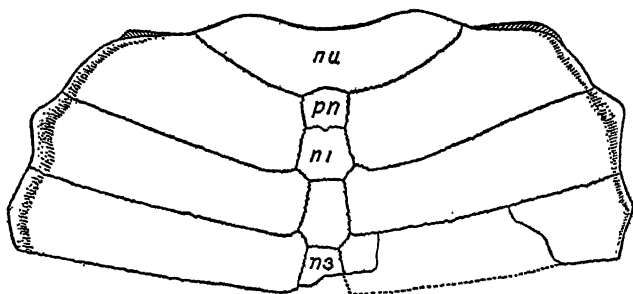


FIGURE 16.—Carapace of *Aspideretes vorax* Hay. U.S.N.M. no. 12988. nu, Nuchal; pn, preneural; n1 and n3, neurals 1 and 3, respectively. One-sixth natural size.

end of the first costal contributes to the formation of the anterior and lateral borders of the shell, as shown in figure 16. It has a greatest width of 82 mm; the second and third each measure 66 mm across their outer ends. The outer ends of the costals are beveled off to a sharp lower edge. This edge is without sculpture. Through the rib the costals have a thickness at their outer ends of 15 mm, at the proximal end 8 mm.

The preneural is quadrangular, being slightly wider than long. Anteroposteriorly it measures 38 mm. The neurals are of the usual coffin shape; the first is 38 mm long, the second 51 mm.

The sculpture of the carapace consists of a network of round-topped ridges surrounding shallow pits. On the outer halves of the costals they tend to arrange themselves in rows running parallel with the adjacent border of the carapace. On the nuchal and the proximal portions of the costals the pits are irregular but evenly distributed. On the neural surfaces and in places on the upper ends of the costal, they are sparsely distributed, in some spots smooth and devoid of ornamentation. The costals have a narrow band along the intercostal sutures formed by a series of low ridges set at right angles to the suture.

As pointed out by Hay (1908, pp. 496-497), *A. vorax* differs from *A. fontanus* and *A. austerus* in having the anterior border of the nuchal beveled instead of clipped off at right angles to the upper surface. The form of the outer end of the first costal also serves to distinguish *vorax* from *austerus*.

U.S.N.M. no. 6550, referred to in a previous paper (Gilmore, 1916) as questionably identified by Hay as *Aspideretes vorax*, can now quite certainly be dismissed from further consideration in that connection. The thinner nuchal and different shape of the first costal, which does not participate in the formation of the anterior border of the carapace, appear sufficient to exclude it from this species.

## Class PISCES

### Family SQUATINIDAE

FIGURE 17

The family of angelfishes, or monkfishes, appears to be represented in the Kirtland formation by a single tooth (fig. 17) found associated with scales of *Lepisosteus* and teeth of *Myledaphus* in SW<sup>1</sup>/<sub>4</sub>, T. 24 N., R. 13 W., San Juan County, N. Mex. The tooth has a conical crown without lateral denticles with a depressed root, much of which is missing. If this identification is correct, the specimen is of interest as being the first representative of the Squatinidae to be found in the Cretaceous of North America.



FIGURE 17.—  
Tooth of  
squatid.  
U.S.N.M. no.  
13655. Inter-  
nal view.  
Twice natural  
size.

#### THE KIRTLAND FAUNA AND ITS GEOLOGICAL AGE

Owing to increased activity in collecting, our knowledge of the Kirtland fauna has been greatly advanced during the past few years. This work has resulted in the discovery of new forms and also in the recovery of well-preserved specimens of species previously known only from meager materials. These specimens permit of a better diagnosis than was previously possible, resulting in a more accurate estimation of the faunal stage represented by the Kirtland formation. The revised faunal list is as follows:

#### DINOSAURIA:

##### Hadrosauridae:

*Kritosaurus navajovius* Brown.

*Parasaurolophus tubicen* Wiman.

##### Ceratopsidae:

*Pentaceratops sternbergii* Osborn.

*Pentaceratops fenestratus* Wiman.

*Chasmosaurus* sp.



## DINOSAURIA—Continued.

## Deinodontidae:

*Gorgosaurus* sp.

## Nodosauridae:

Armored dinosaurs.

## CHELONIA:

## Pleurosternidae:

*Neurankylus baueri* Gilmore.

## Baenidae:

*Baena nodosa* Gilmore.*Baena ornata*, new species.*Baena* sp.*Thescelus hemispherica*, new species.*Boremys grandis*, new species.

## Dermatemydidae:

*Basilemys nobilis* Hay.*Adocus bossi* Gilmore.*Adocus kirtlandius* Gilmore.

## Trionychidae:

*Plastomenus robustus* Gilmore.*Plastomenus* sp.*Aspideretes ovatus*, new species.*Aspideretes vorax* Hay.

Dinosaurian reptiles were the predominating vertebrates of this time, and they afford the most reliable information for correlation with those Upper Cretaceous faunas found elsewhere in North America. Representatives of four families have now been recognized: Deinodontidae, Hadrosauridae, Ceratopsidae, and Nodosauridae. The Deinodontidae are represented by a dentary not distinguishable from the corresponding bone of *Gorgosaurus*, known elsewhere only from the Belly River formation. That other members of this family are present is indicated by fragmentary remains none of which is generically identifiable. The Hadrosauridae are represented by the genera *Parasaurolophus* and *Kritosaurus*, both of which occur elsewhere only in the Belly River of Canada; the Ceratopsidae by the genus *Pentaceratops* and a chasmosaurid, the latter also a Belly River form, but its occurrence in the Kirtland needs additional verification before we can be positive of its assignment. Lull (1933) regards the genus *Pentaceratops* as having a more advanced stage of horn development than is found among the Belly River ceratopsians and finds its nearest complement in those of the Edmonton. In the light of the recently described *Chasmosaurus kaiseni* (Brown, 1933), from the Belly River, with tall brow horns and well-developed nasal horn, it would seem to me this conclusion no longer applies.

The evidence furnished by the known Dinosauria is overwhelmingly in favor of regarding the Kirtland formation as equivalent to the Belly River of Canada, as previously suggested by Brown and

Gilmore. Additional evidence favoring such a conclusion is found in the turtles. The *Chelonia* are now represented by 8 genera and 11 species, all based on adequate specimens. Six of the eight genera are common to the two formations. The genus *Boremys* has not been found elsewhere. *Thescelus* occurs elsewhere in the Lance and *Neurankylus* only in the Benton. *Baena* and *Basilemys* enjoy a wide geological distribution and offer no correlative evidence.

The Crocodilia and Pisces are too fragmentary to be of assistance.

The Upper Cretaceous age of the Kirtland formation is accepted by all, but some differences of opinion exist as to the particular part of the Upper Cretaceous with which it should be correlated.

On the basis of the invertebrate faunas, Drs. T. W. Stanton and J. B. Reeside, Jr., are of the opinion that it is synchronous with the Edmonton, a viewpoint accepted by Prof. Lull (1933) in his revision of the Ceratopsia. Brown, in his first study of the Ojo Alamo, which at that time included the Kirtland, expressed the opinion that it was comparable to the Edmonton. Upon the discovery of *Kritosaurus*, however, Brown (1914) altered his idea to make it synchronous with the Belly River, a viewpoint to which I later gave support (Gilmore, 1916).

In the light of this more recent study of new vertebrate materials, it is my conclusion that the Kirtland and Belly River are equivalent in age. Whether distinct faunas are to be found in the several Upper Cretaceous formations occurring in this area cannot yet be established. Such evidence as there is appears to indicate that genera and even species continue through from the Fruitland to the Ojo Alamo.

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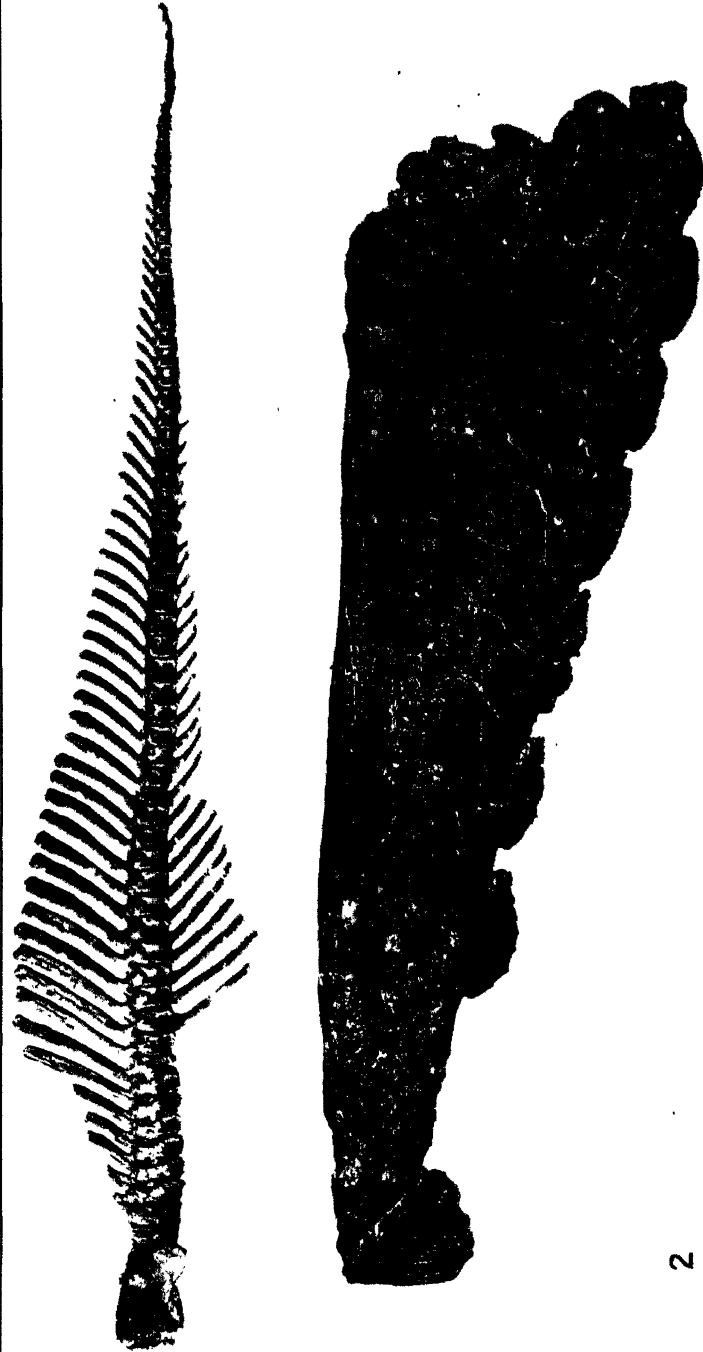
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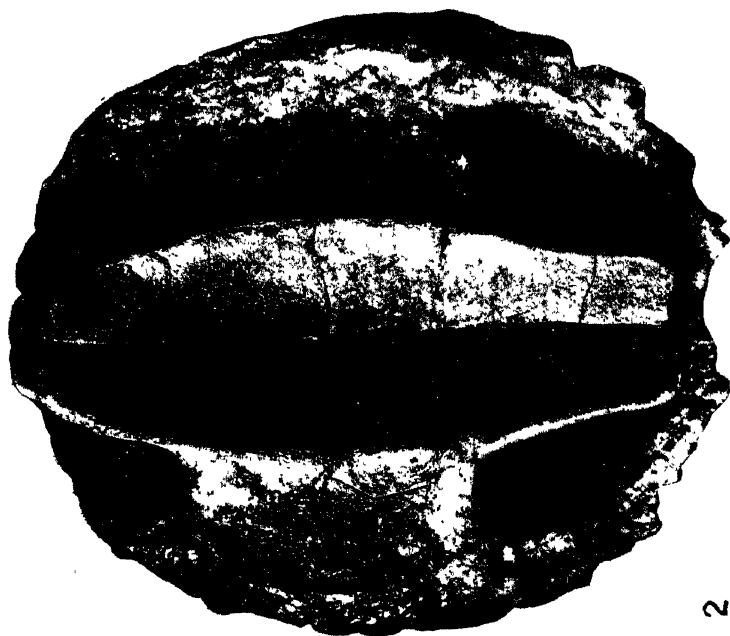
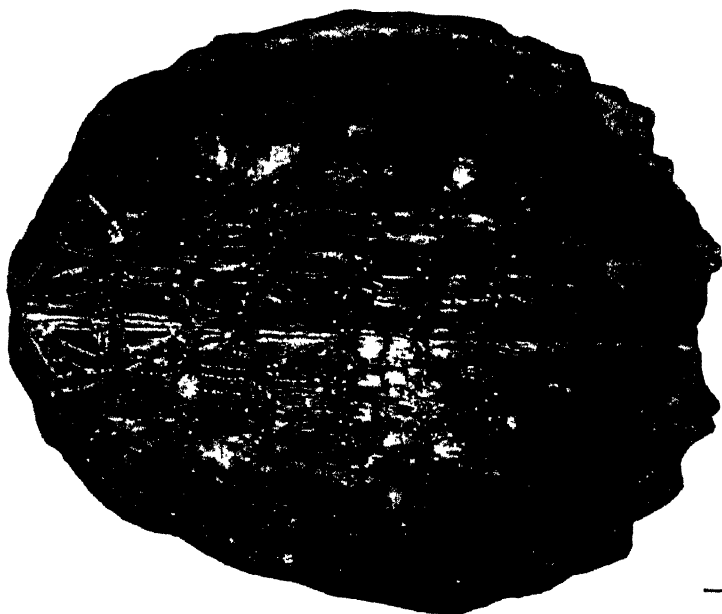
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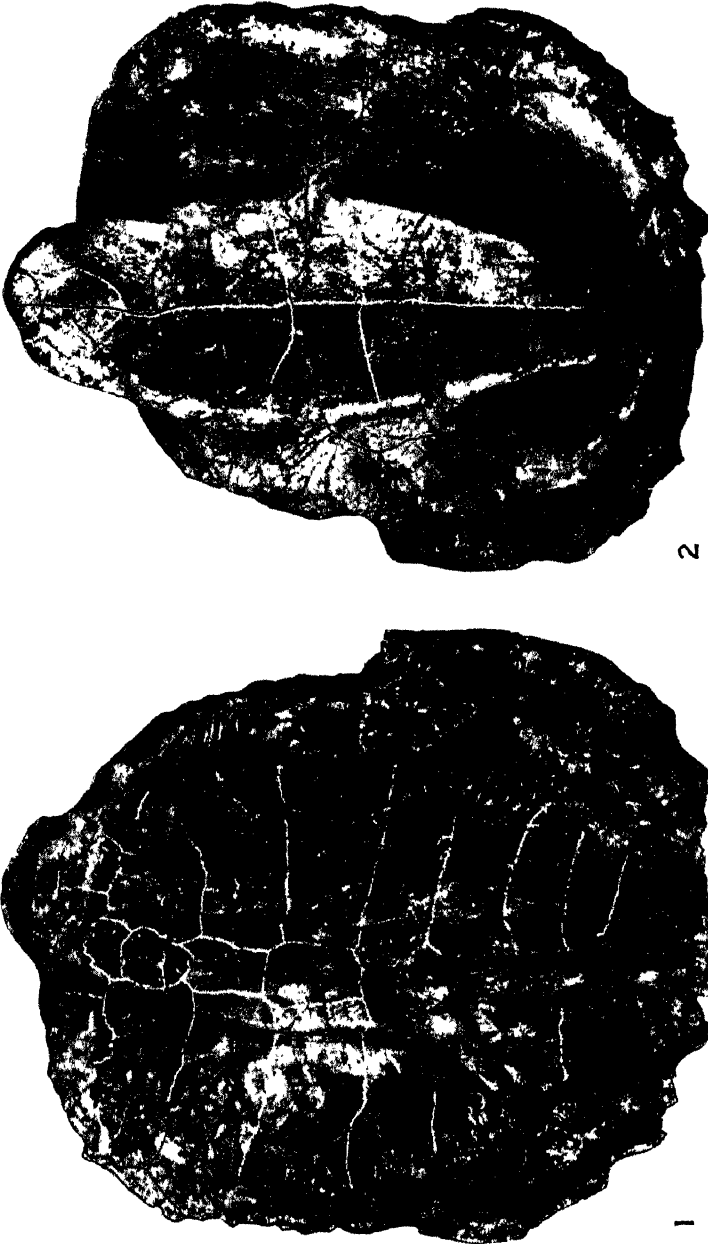
DINOSAURS FROM KIRTLAND FORMATION.

1. Tail of *Parasaurolophus tubicen* (?) Winman. U.S.N.M. no. 13492. Shown as found articulated in the field. Viewed from left side.
2. Right squamosal of *Pentaceratops sternbergii* Osborn. U.S.N.M. no. 12002. Superior view.



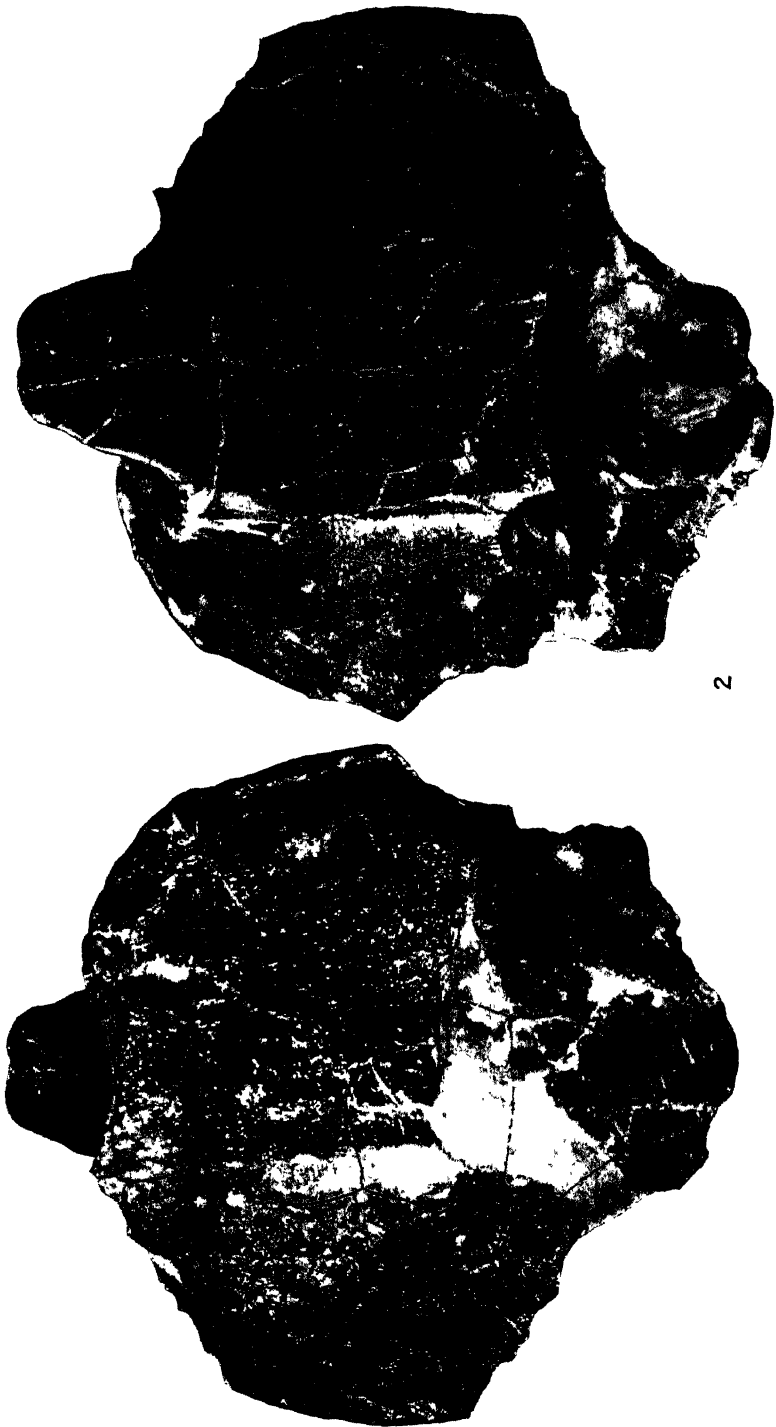
TURTLES FROM KIRTLAND FORMATION.

Carapace (1) and plastron (2) of *Bacina ornata*, new species. U.S.N.M. no. 13229. Type. About one-eighth natural size.



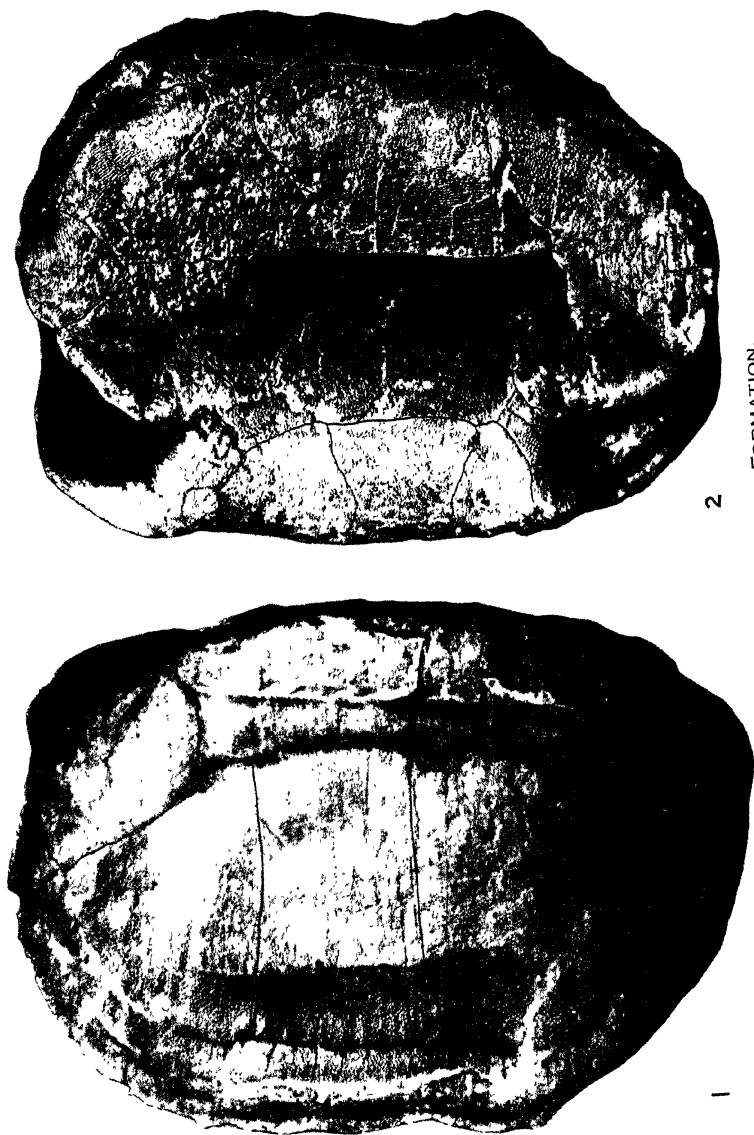
TURTLES FROM KIRTLAND FORMATION.

Carpapace (1) and plastron (2) of *Boremys grandis*, new species. Type, U.S.N.M. no. 12979.  $\times 5.2$ .



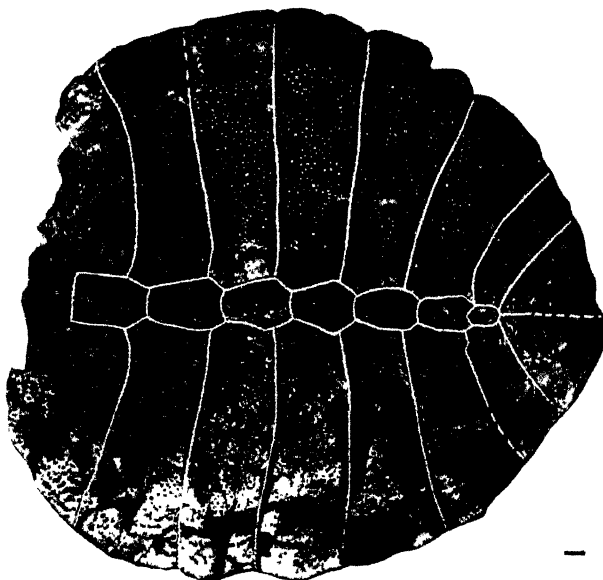
2

TURTLES FROM KIRTLAND FORMATION.  
Carapace (1) and plastron (2) of *Thesocelus hemisphaericus*, new species. U.S.N.M. no. 12818. About one-fourth natural size.



TURTLES FROM KIRTLAND FORMATION.  
Carapace (1) and plastron (2) of *Basilemys nobilis* Hay. U.S.N.M. no. 11084. About one-seventh natural size.





1



2

TURTLES FROM KIRTLAND FORMATION.

1. Carapace of *Aspideretes ontus*, new species. Type. U.S.N.M. no. 12986. X 3.6.
2. Carapace of *Aspideretes vorax* Hay. U.S.N.M. no. 12988. X 4.6.







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## NEW WEST INDIAN CERAMBYCID BEETLES

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THIS PAPER is the result of a study of the beetles of the family Cerambycidae from the West Indies that have accumulated in the collection of the United States National Museum during the past 2 years, including the material in the Wickham collection. It is a continuation of a more extended one published 3 years ago.<sup>1</sup> One genus, 18 species, and 1 variety are described as new.

### PSEUDOEME ORNATA, new species

*Female*.—Elongate, parallel, strongly flattened above, rather strongly shining, above and beneath uniformly pale brownish yellow, with the top of the head and the abdominal segments darker, and the elytra ornamented with dark reddish brown markings.

Head with the front strongly transverse, broadly, feebly concave between the antennal tubercles, which are widely separated and feebly elevated, coarsely, rugosely punctate on occiput, more finely punctate on front, sparsely clothed with inconspicuous, recumbent pubescence, with a few long, erect hairs intermixed, and with a narrow, longitudinal groove extending from epistoma to vertex; eyes

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 80, art. 22, pp. 1-93, 1932.

separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, sparsely, coarsely, feebly punctate, rather densely clothed with moderately long, recumbent and semierect, yellowish hairs, more densely pubescent on apical joints, and rather densely ciliate beneath with long, erect, yellowish hairs; first joint robust, flattened beneath, moderately clavate toward apex, one-half as long as the third joint, which is distinctly longer than the fourth, the following joints nearly equal in length.

Pronotum as wide as long, subequal in width at base and apex, widest at middle; sides strongly, arcuately rounded anteriorly, more obliquely narrowed posteriorly, narrowly constricted at base; disk nearly even, with a vague elevation on each side in front of middle; surface finely, densely, feebly punctate, rather densely clothed with short, recumbent, inconspicuous, yellowish hairs, with a few long, erect hairs intermixed. Scutellum subtriangular, narrowly rounded at apex, slightly concave, sparsely pubescent.

Elytra four times as long as pronotum and slightly wider at base than pronotum at middle; humeri rather strongly developed; sides parallel from base to near the tips, which are separately broadly rounded and feebly emarginate; disk slightly flattened; surface coarsely, densely, uniformly punctate, sparsely, uniformly clothed with short, semierect, and long, erect, yellowish hairs intermixed, and each elytron ornamented with dark reddish brown markings as follows: A broad, transverse fascia at base, a triangular spot at middle, not extending to lateral margin, a similar spot at apical sixth, all these connected to a narrow vitta along the sutural margin.

Abdomen beneath vaguely granulose, feebly punctate, very sparsely clothed with short, semierect, yellowish hairs; last segment broadly subtruncate at apex. Prosternum coarsely, feebly, irregularly punctate, sparsely clothed with short, inconspicuous hairs. Femora slightly flattened, moderately clavate toward apices, petiolate at bases, rather densely clothed with long, semierect, yellowish hairs. Tibiae slender, subcylindrical, clothed with hairs similar to those on the femora.

Length, 11.75 mm; width, 2.75 mm.

*Type locality*.—St. Lucia, British West Indies.

*Type*.—U.S.N.M. no. 50966.

*Remarks*.—Described from a unique female, collected December 18 by A. F. Porter (Wickham collection).

This species is allied to *poolei* Fisher, but it differs from that species in having the femora less strongly clavate and the elytra ornamented with dark reddish brown markings.

*ELAPHIDION MONTICOLA*, new species

Narrowly elongate, subcylindrical, strongly convex above, above and beneath uniformly dark reddish brown, strongly shining, antennae slightly paler, the elytra irregularly ornamented with white pubescent spots.

Head with the front slightly wider than long, flat between the antennal tubercles, which are widely separated and feebly elevated; surface coarsely alveolate-punctate, sparsely clothed with recumbent, whitish hairs, with a spot of dense, recumbent, white pubescence behind each antennal tubercle; eyes deeply emarginate, separated from each other on the top by three times the width of the upper lobe. Antenna about as long as the body, coarsely, sparsely punctate, sparsely clothed with moderately long, recumbent, white hairs, with numerous longer, erect, white hairs intermixed, surface more finely punctured and more densely pubescent on the apical joints; joints feebly spinose; first joint robust, slightly enlarged toward apex, vaguely shorter than the third joint, which is nearly twice as long as the fourth; eleventh joint slightly longer than the tenth.

Pronotum as wide as long, subequal in width at base and apex, widest at middle; sides strongly, arcuately rounded; disk even, moderately convex; surface densely, coarsely alveolate-punctate, the cells deep and elongate, a short, recumbent, white hair arising from each puncture, clothed with a few long, erect, white hairs, and ornamented with dense, recumbent, white pubescence as follows: A very small, transverse spot on each side of middle near lateral margin and a small, elongate spot in front of scutellum. Scutellum broadly triangular, rounded at apex, densely clothed with recumbent, white pubescence.

Elytra three times as long as pronotum, at base slightly wider than pronotum at middle; sides feebly narrowed from base to near the tips, which are separately bispinose, with the outer spine considerably longer than the inner one; surface densely, coarsely, irregularly punctate, clothed with numerous long, erect, white hairs, each elytron irregularly ornamented with small, dense, white pubescent spots, with a more conspicuous, narrow, irregular, V-shaped fascia at middle and a transversely arcuate fascia at apical fifth.

Abdomen beneath sparsely, finely, irregularly punctate, feebly granulose, sparsely clothed with long, recumbent and semierect, white hairs intermixed; last segment broadly rounded at apex. Prosternum sparsely, coarsely punctate, feebly granulose, transversely rugose anteriorly, sparsely clothed with long, semierect, white hairs; prosternal process very narrow, feebly expanded and arcuately declivous posteriorly. Mesosternum rather narrow between the coxal cavities, slightly declivous anteriorly. Legs rather long, sparsely, irregu-

larly clothed with long, recumbent and erect, white hairs; femora strongly clavate, but not spinose at apices.

Length, 6.25–7.75 mm; width, 1.5–2 mm.

*Type locality*.—Pan de Matanzas Mountain, Cuba.

*Type*.—U.S.N.M. no. 50967.

*Paratype*.—In S. C. Bruner collection.

*Remarks*.—Described from two specimens (one type). The type was collected June 12, 1932, by S. C. Bruner, A. R. Otero, and L. C. Scaramuzza, and the paratype was collected on the same date by F. Zayas (Cuba E. E. A. Ent. no. 9943).

This species is very closely allied to *antillarum* Fisher, but it differs from that species in having the pubescence on the elytra sparser, the hairs on the white pubescent spots on the pronotum and elytra denser and more conspicuous, and the tips of the elytra bispinose.

**ELAPHIDION WICKHAMI, new species**

Broadly elongate, moderately convex above, and similar in form to *lanatum* Chevrolat. Above and beneath uniformly reddish brown, moderately shining, and irregularly clothed with recumbent, whitish pubescence.

Head with the front distinctly wider than long, flat between the antennal tubercles, which are widely separated and feebly elevated; surface feebly, coarsely, irregularly punctate, more or less longitudinally rugose, sparsely, irregularly clothed with long, recumbent, whitish pubescence, and with a narrow, longitudinal groove on the front; eyes deeply emarginate, separated from each other on the top by twice the width of the upper lobe. Antenna a little longer than the body, four or five basal joints coarsely, irregularly punctate and rugose, sparsely, irregularly clothed with moderately long, recumbent, whitish hairs, with numerous long, erect, whitish hairs on the underside of the joints, the following joints finely, densely punctate, rather densely clothed with short, recumbent, whitish pubescence, and joints 3 to 10 bispinose at apices; first joint robust, strongly clavate, slightly flattened on top, subequal in length to the fourth joint, which is slightly shorter than the third, the following joints gradually diminishing in length; eleventh joint subequal in length to the tenth, broadly rounded at apex.

Pronotum one-fourth wider than long, subequal in width at base and apex, widest at middle; sides strongly, arcuately rounded, feebly constricted at base; disk rather strongly, evenly convex, ornamented with smooth, glabrous elevations as follows: A narrow, longitudinal, median elevation extending from anterior margin to near the base; a round elevation on each side in front of middle, behind which is an irregular, elongate elevation; and a few small, irregularly distributed

elevations on each side along lateral margin; surface rather finely, confluent punctate, sparsely, irregularly clothed with long, recumbent, whitish pubescence. Scutellum broadly triangular, broadly rounded at apex, clothed with long, recumbent, whitish hairs.

Elytra nearly four times as long as pronotum, at base as wide as pronotum at middle; sides parallel from base to near the tips, which are separately bispinose, with the outer spine considerably longer than the inner one; surface coarsely, irregularly punctate basally, the punctures becoming finer and obsolete toward apices, sparsely, irregularly clothed with long, recumbent, whitish pubescence, not concealing the surface, but giving it a variegated appearance.

Abdomen beneath feebly, sparsely punctate, obsoletely granulose, sparsely, irregularly clothed with long, recumbent, whitish pubescence; last segment broadly subtruncate at apex. Prosternum rather finely, confluent punctate, sparsely clothed with long, recumbent, whitish pubescence; prosternal process rather narrow, flat, expanded posteriorly, truncate and abruptly declivous at apex. Mesoternum abruptly declivous in front. Femora slender, slightly clavate toward apices, the middle and posterior pairs bispinose at apices, with the inner spine considerably longer than the outer one.

Length, 14–20 mm; width, 3.75–5 mm.

*Type locality*.—Eleuthera, Bahama Islands.

*Type and paratypes*.—U.S.N.M. no. 50968.

*Paratype*.—In American Museum of Natural History.

*Remarks*.—Described from five specimens (one type) collected July 9–15 by H. F. Wickham.

This species is closely allied to *lanatum* Chevrolat, but it differs from that species in being more sparsely, irregularly clothed above and beneath with whitish pubescence. It is also allied to *manni* Fisher, but it differs from that species in being more sparsely pubescent, and in having the pronotum evenly convex, without any depressions. A. J. Mutchler has kindly compared a specimen of this species with the type of *manni* in the American Museum of Natural History.

**ANEPSTRA JAUMEL, new species**

Narrowly elongate, subcylindrical, slightly flattened above, rather strongly shining; above and beneath uniformly pale brownish yellow, except the head, which is brownish black in front, and the elytra, which are ornamented with two transverse, black fasciae.

Head with the front slightly wider than long, flat between the antennal tubercles, which are widely separated and feebly elevated; surface very coarsely, densely, irregularly punctate, clothed with a few long, erect hairs; eyes deeply emarginate, separated from each



other on the top by twice the width of the upper lobe. Antenna about as long as the body, basal joints subcylindrical, sparsely punctate, sparsely clothed with recumbent, yellowish pubescence, with numerous long, erect hairs intermixed, apical joints more or less flattened, finely, densely punctate, and more densely pubescent; joints 3 to 7 unispinose, the spine on the third joint nearly as long as the fourth joint and rounded at apex; first joint robust, subcylindrical, slightly shorter than third joint, which is distinctly longer than the fourth.

Pronotum cylindrical, longer than wide, subequal in width at base and apex, widest at middle; sides moderately, arcuately rounded, vaguely constricted at base and apex; disk even, strongly convex; surface sparsely, coarsely, irregularly punctate on disk, more finely, densely punctate toward sides, clothed with a few long, erect, inconspicuous hairs. Scutellum transverse, broadly rounded at apex, sparsely pubescent.

Elytra nearly three times as long as pronotum, at base subequal in width to pronotum at middle; sides parallel from base to near the tips, which are separately bispinose, with the outer spine much longer than the inner one; surface coarsely, densely, irregularly punctate basally, the punctures becoming finer and more distant toward the apices, sparsely clothed with long, erect, yellowish hairs; each elytron ornamented with two transverse, black fasciae, a rather broad one at basal fourth, not extending to lateral or sutural margins, and a very broad one at apical third.

Abdomen beneath impunctate, clothed with a few long, semierect, yellowish hairs; last segment broadly rounded at apex. Prosternum feebly punctate; prosternal process very narrow, feebly expanded and arcuately declivous posteriorly. Mesosternum rather narrow between the coxal cavities, arcuately declivous in front. Legs rather long, sparsely clothed with long, semierect, yellowish hairs; femora moderately clavate, but not spinose at apices.

Length, 7.5–9 mm; width, 1.62–1.87 mm.

*Type locality*.—Corralillo, Santa Clara, Cuba.

*Type*.—U.S.N.M. no. 50969.

*Paratype*.—Returned to Miguel L. Jaume.

*Remarks*.—Described from two specimens (one type) collected by Miguel L. Jaume and Manuel Barro. The type was collected at the type locality, June 13, 1933, and the paratype was collected at Puente Almendares, Habana, Cuba, June 6, 1932.

This species differs from the other known species of the tribe Phoracanthini found in the West Indies in being of a uniform, brownish yellow color, and in having the elytra ornamented with two transverse, black fasciae, and the spine on the third joint of the antennae nearly as long as the fourth joint.

**HARUSPEX INSULARIS**, new species

Elongate, slightly flattened above, subopaque; antennae, and head in front, pale reddish brown; posterior part of head and pronotum dark reddish brown, the latter with the anterior margin and a small spot in front of scutellum paler; elytra brownish yellow, ornamented with dark reddish brown vittae and fasciae; beneath yellowish or reddish brown, with the prosternum, mesosternum, and metasternum slightly darker.

Head with the front wider than long, flat between the antennal tubercles, which are scarcely elevated; surface coarsely, confluent punctate, more or less rugose; eyes feebly emarginate. Antenna slender, coarsely punctate, sparsely ciliate beneath, with joints 3 to 10 longitudinally sulcate and carinate; first joint robust, slightly shorter than the third joint, the following joints subequal in length.

Pronotum slightly wider than long, subequal in width at base and apex, widest at middle; sides strongly, arcuately rounded, distinctly constricted at base; disk slightly uneven, moderately convex, narrowly, transversely flattened along base, with a triangular depression in front of scutellum; surface coarsely, densely, rugosely punctate. Scutellum as wide as long, broadly rounded at apex.

Elytra three and one-half times as long as pronotum, at base slightly wider than pronotum at middle; sides nearly parallel from base to near the tips, which are separately feebly emarginate or subtruncate; surface coarsely, densely, irregularly punctate, sparsely, uniformly clothed with short, stiff, erect, yellow hairs; each elytron with a vague, longitudinal costa on disk, and ornamented with reddish brown markings as follows: A narrow, transversely oblique fascia just behind the middle, connected to a narrow vitta extending forward along the sutural margin to the scutellum, and a similar fascia near the apex, the two fasciae connected externally to a narrow vitta extending along the lateral declivity from the humerus to the apical fascia.

Abdomen beneath feebly granulose, vaguely punctate, sparsely clothed with inconspicuous, recumbent hairs; last segment broadly rounded at apex.

Length, 7.75 mm; width, 2 mm.

*Type locality*.—Barbados, British West Indies.

*Type*.—U.S.N.M. no. 50970.

*Remarks*.—Described from a single specimen collected during October 1902 by Miss Field (Wickham collection).

This species is allied to *inscriptus* Gahan, but it differs from the description given for that species in the different arrangement of the reddish-brown markings on the elytra.

## HARUSPEX SIMILIS, new species

This species is closely allied to *insularis* Fisher, but it differs from that species in having the pronotum more uniformly reddish brown and in having the reddish-brown markings on each elytron arranged as follows: A narrow vitta along sutural margin behind the scutellum; a narrow, irregular fascia extending obliquely backward from the humerus to the middle of disk at middle, and a narrow fascia extending obliquely backward from the sutural margin at middle to the middle of disk at apical third, the two fasciae connected externally to a narrow, irregular vitta along the lateral declivity.

Length, 8.75 mm; width, 2.25 mm.

*Type locality*.—Trinidad, West Indies.

*Type*.—U.S.N.M. no. 50971.

*Remarks*.—Described from a single specimen collected during June, by August Busck. With a good series of specimens for study, *insularis* Fisher and *similis* Fisher may prove to be simply varieties of *inscriptus* Gahan.

## NANILLA TUBERCULATA, new species

Short, oval, strongly convex, subopaque, uniformly dark reddish brown, with the tarsi and bases and apices of antennal joints yellowish, and the elytra inconspicuously ornamented with whitish pubescence.

Head with the front strongly transverse, nearly flat, feebly, broadly concave between the antennal tubercles, which are widely separated and feebly elevated, with a vague, longitudinal groove extending from occiput to middle of front; surface coarsely, confluent punctate, sparsely clothed with short, recumbent, whitish pubescence; eyes small, narrow, rather deeply emarginate, separated from each other on the top by four times the width of the upper lobe. Antenna nearly as long as the body, rather densely clothed with short, recumbent pubescence; first joint robust, oblong, flattened beneath at base, subequal in length to the fourth joint, which is two-thirds as long as the third, the following joints slightly shorter than the fourth and subequal in length.

Pronotum distinctly wider than long, narrower at apex than at base, widest at middle; sides strongly, arcuately rounded; disk strongly convex, more or less transversely gibbose at middle, feebly, transversely flattened anteriorly; surface coarsely, confluent punctate, rather densely clothed at the sides with short, recumbent, whitish, scalelike hairs. Scutellum strongly transverse, broadly rounded at apex, feebly concave at middle.

Elytra two and one-half times as long as pronotum, at base subequal in width to pronotum at middle, widest at middle; sides strongly,

arcuately rounded from base to the tips, which are separately narrowly rounded; disk nearly hemispherical, strongly, obliquely declivous posteriorly; surface coarsely, densely, irregularly punctate, rather densely clothed with short, recumbent, whitish, scalelike hairs, with a few longer, erect, scalelike hairs intermixed, each elytron ornamented with a few more or less distinct, whitish pubescent spots posteriorly, and with three longitudinal rows of irregularly separated, elongate tubercles, a slightly elevated, longitudinal costa between each row of tubercles, and two round, obtuse tubercles at the posterior declivity.

Abdomen beneath coarsely, confluent punctate, rather densely clothed with moderately long, recumbent, whitish hairs; last segment broadly rounded or subtruncate at apex.

Length, 4.25 mm; width, 2.25 mm.

*Type locality*.—Buenos Aires, Trinidad Mountains, Cuba.

*Type*.—U.S.N.M. no. 50972.

*Remarks*.—Described from a single specimen collected May 4, 1932, by S. C. Bruner and A. R. Otero (Cuba E. E. A. Ent. no. 9909).

This species is allied to *delanneyi* Fleutiaux and Sallé, but it differs from the description given for that species in having three longitudinal rows of tubercles and two additional round, obtusely elevated tubercles on each elytron.

#### ACREPIDOPTERUM MINUTUM APICALIS, new variety

This form differs from *minutum* Fisher, described from Cuba, in having a distinct, round, brown spot near the apex of each elytron, and in not having the large U-shaped brown spot behind the middle, nor the longitudinal spot of the same color on each elytron behind the scutellum.

Length, 4 mm; width, 1.25 mm.

*Type locality*.—Mandeville, Jamaica.

*Type and paratype*.—U.S.N.M. no. 50973.

*Remarks*.—Described from two specimens (one type) from the Wickham collection, collected April 1-4, 1906, by E. P. Van Duzee.

#### EUPOGONIUS HAITIENSIS, new species

Elongate, rather robust, nearly parallel, uniformly dark reddish brown, with the tibiae and basal halves of the antennal joints paler.

Head with the front strongly transverse, feebly convex, flat between the antennal tubercles, which are widely separated and slightly elevated; surface sparsely, coarsely punctate, rather densely clothed with long, recumbent, brownish yellow pubescence, with numerous long, fine, erect hairs intermixed, the pubescence not concealing the punctures; eyes coarsely granulated, deeply emarginate, separated

from each other on the top by twice the width of the upper lobe. Antenna as long as the body, rather densely clothed with short, recumbent, brownish-yellow pubescence (except the basal two-thirds of the fourth joint, which is clothed with whitish pubescence) and numerous long, erect hairs intermixed; first joint robust, subcylindrical, one-half as long as third joint, which is considerably longer than the fourth, the following joints much shorter and nearly equal in length.

Pronotum slightly wider than long, subequal in width at base and apex; sides nearly parallel, without a distinct tubercle at middle; disk uniformly convex, feebly, broadly, transversely depressed at base; surface rather densely, coarsely, uniformly punctate, rather densely clothed with long, recumbent, brownish-yellow pubescence, which does not conceal the punctures, with numerous long, fine, erect hairs intermixed, and ornamented with a narrow, longitudinal, median vitta of dense, white pubescence, extending from anterior margin to base. Scutellum strongly transverse, densely clothed with white pubescence.

Elytra three and one-half times as long as pronotum, considerably wider than pronotum at base; humeral angles broadly rounded; sides nearly parallel from base to apical fourth, then arcuately narrowed to the tips, which are separately rather broadly rounded; disk moderately convex, surface sparsely, coarsely, irregularly punctate, rather densely, irregularly variegated with long, recumbent, brownish-yellow and whitish pubescence, the brownish pubescence predominating, and with numerous long, erect hairs intermixed, the pubescence concealing the punctures in some places.

Abdomen beneath coarsely, sparsely punctate, rather densely clothed with long, recumbent, brownish-yellow pubescence, with numerous long, fine, erect hairs intermixed, glabrous around the punctures, giving the surface a mottled appearance; last segment broadly, feebly depressed posteriorly, broadly, arcuately emarginate at apex. Femora strongly expanded toward apices. Tibiae rather robust, subcylindrical, gradually expanded toward apices.

Length, 7.5 mm; width, 2.75 mm.

*Type locality*.—Plaisance, Haiti.

*Type*.—U.S.N.M. no. 50974.

*Remarks*.—Described from a single specimen collected July 5, 1931, on rose apple, by Max Kisiuk, Jr., and C. E. Cooley.

This species is allied to *pilosulus* Chevrolat, but it differs from that species in having the elytra variegated with brownish yellow and whitish pubescence and in having a longitudinal, median, white pubescent vitta on the pronotum.

## EUPOGONIUS WICKHAMI, new species

This species is closely allied to *haitiensis* Fisher, but it differs from that species in being smaller, narrower, and more cylindrical; in having the antenna shorter than the body, only ciliate beneath with long, erect hairs, the third and fourth joints clothed with whitish pubescence on basal two-thirds, the apical joints more sparsely pubescent, and feebly, narrowly annulated with white pubescence at the bases, the elytra more evenly variegated with paler yellow and white pubescence, the whitish pubescence predominating; and in having the erect hairs on the legs shorter and sparser.

Length, 6.25–6.75 mm; width, 2.12–2.25 mm.

*Type locality*.—Egg Island, Bahamas.

*Type and paratype*.—U.S.N.M. no. 50975.

*Remarks*.—Described from two specimens (one type). The type was collected at the type locality on May 13 by H. F. Wickham, and the paratype was collected at Blue Hill, Nassau, New Providence Island, Bahamas, May 29, 1931, in lint of wild cotton, by Max Kisliuk, Jr.

## HYPSIOMA INSULARIS, new species

Robust, elongate-triangular, uniformly dark reddish brown, with the basal two-thirds of the antennal joints pale yellow, and the surface above and beneath concealed by the dense, pale brownish white and whitish pubescence.

Head with the front longer than wide, flat, the sides parallel and elevated, flat between the antennal tubercles, which are strongly elevated, nearly contiguous at bases, and obliquely divergent; surface with a narrow, longitudinal groove extending from occiput to epistoma, coarsely, sparsely punctate, variegated with rather long, dense, recumbent, somewhat wavy, brownish white and whitish pubescence. Eyes coarsely granulated, deeply emarginate, separated from each other on the top by twice the width of the upper lobe, the lower lobe longer than wide. Antenna about as long as the body, rather densely ciliate beneath, densely clothed with short, recumbent pubescence, which is whitish on the basal two-thirds and variegated on the apical third of the joints; first joint elongate, subcylindrical, strongly, rather abruptly clavate toward apex, slightly longer than the fourth joint, which is two-thirds as long as the third, the third joint slightly arcuate.

Pronotum two-thirds wider than long, slightly narrower at apex than at base; sides unarmed, slightly sinuate, feebly narrowed from base to apex; disk uneven, more or less tumid on each side of middle, feebly, narrowly, transversely depressed near base and anterior margin; surface sparsely, coarsely, irregularly punctate, variegated

with long, dense, recumbent, more or less wavy, brownish white and whitish pubescence. Scutellum strongly transverse, broadly rounded at apex, longitudinally glabrous at middle, densely clothed with long, recumbent, brownish white pubescence at sides.

Elytra four times as long as pronotum, distinctly wider than pronotum at base; humeri strongly elevated and each armed with a glabrous, obtuse tubercle; sides strongly, obliquely narrowed from base to near the tips, which are separately broadly rounded; disk moderately convex; surface coarsely, sparsely, irregularly punctate, densely clothed with long, recumbent, brownish-white pubescence, and inconspicuously ornamented posteriorly with numerous short, narrow, wavy, whitish pubescent lines.

Body beneath densely clothed with long, recumbent, brownish-white pubescence, which conceals the surface; the legs variegated with dark brown pubescence; last abdominal segment feebly emarginate or subtruncate at apex.

Length, 17 mm; width, 8 mm.

*Type locality*.—Barbados, British West Indies.

*Type*.—U.S.N.M. no. 50976.

*Remarks*.—Described from a single specimen from the Wickham collection labeled "Chelston, Barbados, Lady Morris, 11-12-06, No. 834."

This species is allied to *picticornis* Bates, but it differs from that species in having the upper surface densely clothed with brownish white pubescence and the elytra inconspicuously ornamented posteriorly with short, narrow, wavy, whitish pubescent lines.

#### SPALACOPSIS ORNATIPENNIS, new species

Very slender, strongly flattened above, uniformly dark reddish brown, the antennal joints slightly paler at bases, and densely clothed above with very short, whitish and dark brown pubescence.

Head beneath finely, sparsely punctate, densely clothed with short, curly, white hairs; above sparsely, finely punctate, rather densely clothed with short, recumbent, brownish-yellow hairs, with a few short, erect, white hairs intermixed, and ornamented with three longitudinal vittae of dense, short, recumbent, yellowish white pubescence, one median and one on each side along lateral margin. Antenna about as long as the body, rather densely clothed with short, recumbent, yellowish hairs, with numerous erect hairs intermixed, and densely ciliate beneath with long, flying, blackish hairs.

Pronotum twice as long as wide, subequal in width at base and apex, subcylindrical; sides feebly sinuate, parallel; disk strongly convex; surface coarsely, sparsely, irregularly punctate, densely clothed with short, recumbent, brownish-yellow and yellowish-white

pubescence, with a few short, erect, white hairs intermixed, ornamented on each side along lateral margin with a narrow vitta of dense, whitish pubescence, and with a small, narrow, glabrous spot at middle of disk. Scutellum elongate, sides parallel, densely clothed with yellowish white pubescence.

Elytra four times as long as pronotum, at base as wide as pronotum; sides feebly, obliquely expanded from base to near the tips, which are divaricate and separately broadly rounded; disk strongly flattened, each elytron with three distinctly elevated, longitudinal costae, not including the sutural margin, the first extending from base to basal third, and the second connected to the lateral one near apex; surface with two longitudinal rows of deep, coarse punctures between each costa, sparsely clothed between the costae with very short, brownish hairs, the costae on basal halves densely clothed with short, recumbent, whitish pubescence, each elytron ornamented near apex with an oblique, dense, white pubescent spot or fascia.

Body beneath coarsely, rather sparsely, irregularly punctate, densely clothed with recumbent, brownish-yellow and yellowish-white pubescence, with a few erect, whitish hairs intermixed, the pubescence on sternum more uniformly white, erect, and more or less curly; last abdominal segment broadly subtruncate or feebly emarginate at apex.

Length, 10 mm; width, 1.35 mm.

*Type locality*.—Mandeville, Jamaica.

*Type*.—U.S.N.M. no. 50977.

*Remarks*.—Described from a single specimen from the Wickham collection, collected April 1-4, 1906, by E. P. Van Duzee.

This species is very closely allied to *grandis* Chevrolat, but it differs from that species in having the pubescence distinctly shorter, the elytra gradually expanded toward the apices, with the longitudinal costae strongly elevated, and each elytron ornamented with a distinct whitish pubescent spot or fascia near the apex.

#### LEPTOSTYLUS MONTICOLA, new species

Moderately robust, convex above, brownish yellow to reddish brown, with the tips of the antennae slightly darker, rather densely clothed with whitish pubescence, and ornamented with dark brown markings.

Head with the front slightly transverse, slightly convex, feebly depressed between the antennal tubercles, which are moderately elevated and rather widely separated, with a narrow, longitudinal groove extending from occiput to epistoma; surface indistinctly punctate, densely, irregularly clothed with long, recumbent, whitish pubescence, nearly concealing the surface, causing a variegated ap-



pearance; eyes separated from each other on the top by twice the width of the upper lobe. Antenna about one-fourth longer than the body, variegated with brown and white pubescence.

Pronotum four-fifths wider than long, subequal in width at base and apex, widest at middle; sides feebly, obliquely expanded from apical angles to a feeble tubercle on each side at middle, the tubercle slightly acute at apex, then obliquely narrowed to the base; disk flattened along base, narrowly, transversely depressed along anterior margin, with two slightly elevated, obtusely rounded tubercles, arranged transversely on disk at apical third; surface coarsely, deeply, irregularly punctate, with a row of similar punctures along base and anterior depression, rather densely clothed with short, recumbent, white and pale yellow pubescence intermixed, and ornamented with dark brown pubescence as follows: A small, elongate spot in front of scutellum, and a large spot on each side behind the lateral tubercle. Scutellum broadly triangular, broadly rounded at apex, sparsely pubescent.

Elytra three-fourths longer than wide, distinctly wider than pronotum at middle; humeri prominent and slightly elevated; sides nearly parallel to behind middle, then arcuately narrowed to the tips, which are separately, narrowly, obliquely truncate internally, the exterior angle obtuse, but not produced; disk uneven, with a few moderately elevated tubercles near base; surface coarsely, deeply, irregularly punctate from bases to apices, densely clothed with moderately long, recumbent, brownish-white pubescence, each elytron ornamented with dark brown pubescence as follows: A small spot at humeral angle; a few irregularly distributed, round spots; an irregular, inconspicuous, transverse spot near base; and a narrow, irregular fascia extending obliquely backward from sutural margin at middle to middle of disk at apical fourth, in front of which is a similar fascia extending obliquely forward from lateral margin at apical fifth to middle of disk just behind the middle.

Beneath feebly granulose, rather densely clothed with long, recumbent, brownish white pubescence, the legs variegated with white and brown pubescence; tibiae annulated with brown pubescence; femora strongly pedunculate; prosternal process three-fourths as wide as coxal cavity.

Length, 7 mm; width, 3 mm.

*Type locality*.—Pan de Matanzas Mountain, Matanzas Province, Cuba.

*Type*.—U.S.N.M. no. 50978.

*Remarks*.—Described from a single specimen collected June 12, 1932, by S. C. Bruner, A. R. Otero, and L. C. Scaramuzza (Cuba E. E. A. Ent. no. 9945).

This species is allied to *ornatus* Fisher, but it differs from that species in having an oblique, dark brown pubescent fascia on the elytra.

LEPTOSTYLUS PLANICOLLIS, new species

Small, elongate, moderately flattened above, brownish yellow, densely clothed with white and pale yellow pubescence, and inconspicuously ornamented with darker pubescence.

Head with the front quadrate, slightly convex, feebly depressed between the antennal tubercles, which are moderately elevated and widely separated, with a narrow, longitudinal groove extending from occiput to epistoma; surface indistinctly punctate, densely, irregularly clothed with rather short, recumbent, white and pale yellow pubescence intermixed, nearly concealing the surface; eyes separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, variegated with white and brown pubescence, the outer joints feebly annulated with brown pubescence.

Pronotum two-thirds wider than long, slightly narrower at base than at apex, widest at basal third; sides feebly, obliquely expanded to basal third, then strongly, arcuately narrowed to near the base, parallel and narrowly constricted at base; disk even, feebly, narrowly, transversely depressed along base; surface indistinctly punctate, densely clothed with rather short, recumbent, white and pale yellow pubescence intermixed. Scutellum broadly triangular, rather narrowly rounded at apex, densely pubescent.

Elytra three-fourths longer than wide, slightly wider than pronotum at basal third; humeri not prominent; sides parallel to behind middle, then arcuately narrowed to the tips, which are separately narrowly rounded; disk even, without distinct tubercles; surface coarsely, irregularly punctate basally, the punctures becoming obsolete toward apices, densely clothed with moderately long, recumbent, white and pale yellow pubescence, with numerous small, round, irregularly distributed, brown pubescent spots, and each elytron with a large, elongate, more or less conspicuous, brownish spot on external half of disk, the spot extending from basal third to apical fourth, and more distinct on inner margin.

Beneath feebly granulose, rather densely clothed with long, recumbent, whitish pubescence, the legs slightly variegated with white and brown pubescence; femora strongly pedunculate; prosternal process two-thirds as wide as coxal cavity.

Length, 4.25 mm; width, 1.75 mm.

*Type locality*.—Montego Bay, Jamaica.

*Type*.—U.S.N.M. no. 50979.

*Remarks.*—Described from a single specimen from the Wickham collection, collected in April 1906 by E. P. Van Duzee.

This species is allied to *biustus* LeConte, but it differs from that species in being shorter, more robust, and without distinct tubercles on the elytra and in having the tips of the elytra narrowly rounded, each elytron ornamented with a large, indistinct, brown pubescent spot.

LEPTOSTYLUS VANDUZEEI, new species

Small, elongate, moderately flattened above, reddish brown to brownish yellow, densely clothed with whitish and brownish-white pubescence, and ornamented with dark brown or blackish pubescent spots.

Head with the front quadrate, slightly convex, feebly depressed between the antennal tubercles, which are rather strongly elevated and obliquely divergent, with a narrow, longitudinal groove extending from occiput to epistoma; surface indistinctly punctate, densely, irregularly clothed with long, recumbent, white and brownish yellow pubescence intermixed; eyes separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, variegated with white and brown pubescence, the outer joints annulated with brown pubescence.

Pronotum twice as wide as long, slightly narrower at base than at apex, widest at basal third; sides feebly, obliquely expanded to basal third, then strongly, arcuately narrowed to near the base, parallel and narrowly constricted at base; disk even, feebly, broadly, transversely concave along base; surface indistinctly punctate, densely clothed with rather short, recumbent, white and brownish white pubescence intermixed. Scutellum broadly triangular, rather acutely rounded at apex, densely pubescent.

Elytra three-fourths longer than wide, and subequal in width to the pronotum at basal third; humeri not prominent; sides parallel to behind middle, then arcuately narrowed to the tips, which are separately narrowly rounded; disk even, without distinct tubercles; surface inconspicuously punctate, the punctures concealed by the dense, long, recumbent, pale brown and white pubescence, the white pubescence forming small, more or less distinct spots, with numerous small, round, irregularly distributed, dark brown pubescent spots, and a large, round, dark brown pubescent spot behind the scutellum, common to both elytra, each elytron ornamented with brown pubescence as follows: A narrow, short, oblique, inconspicuous fascia along sutural margin just behind the middle, and a similar fascia along lateral margin at apical fifth.

Beneath feebly granulose, rather densely clothed with long, recumbent, whitish pubescence, the sternum and legs variegated with white

and brown pubescence; tibiae annulated with brown pubescence; femora strongly pedunculate; prosternal process one-half as wide as coxal cavity.

Length, 4.5 mm; width, 1.75 mm.

*Type locality*.—Mandeville, Jamaica.

*Type*.—U.S.N.M. no. 50980.

*Remarks*.—Described from a single specimen from the Wickham collection, collected April 1-4, 1906, by E. P. Van Duzee.

This species is allied to *maculifer* Fisher, but it differs from that species in having the pronotum as wide as the elytra and in having a dark brown pubescent spot behind the scutellum instead of behind the middle of the elytra.

LEPTOSTYLUS BRUNNEOFASCIATUS, new species

Small, elongate, moderately flattened above, brownish yellow to reddish brown, clothed with white and pale yellow pubescence intermixed and ornamented with dark brown pubescence.

Head with the front quadrate, slightly convex, feebly depressed between the antennal tubercles, which are strongly elevated and obliquely divergent, with a narrow, longitudinal groove extending from occiput to epistoma; surface indistinctly punctuate, rather sparsely, irregularly clothed with long, recumbent, white and brownish yellow pubescence intermixed; eyes separated from each other on the top by the width of the upper lobe. Antenna broken, variegated with white and brown pubescence, the outer joints annulated with dark brown pubescence.

Pronotum twice as wide as long, subequal in width at base and apex, widest near middle; sides feebly, obliquely expanded to middle, then accurately narrowed to near the base, parallel and strongly constricted at base; disk even, feebly, transversely depressed along anterior margin, feebly, broadly, transversely concave along base; surface indistinctly punctuate, rather sparsely clothed with short, recumbent, white and pale yellow pubescence intermixed, with a small brown pubescent spot along lateral margin at middle. Scutellum triangular, broadly rounded at apex, densely pubescent.

Elytra nearly twice as long as wide, distinctly wider than pronotum at basal third; humeri not prominent; sides parallel to behind middle, then artuately narrowed to the tips, which are separately feebly, obliquely truncate internally; disk even, with a feeble tubercle clothed with brown pubescence near base of each elytron; surface rather finely, densely, irregularly punctate from bases to apices, densely clothed with moderately long, recumbent, white and pale yellow pubescence intermixed, each elytron ornamented with dark brown pubescence as follows: A few small, round spots along sutural

and lateral margins, and a rather broad, irregular, transverse fascia at middle, connected laterally to a fascia extending forward to lateral margin at basal fourth.

Beneath feebly granulose, rather sparsely clothed with inconspicuous, whitish pubescence, the legs feebly variegated with white and brown pubescence; femora strongly pedunculate; prosternal process one-third as wide as coxal cavity.

Length, 8 mm; width, 1.25 mm.

*Type locality*.—Mandeville, Jamaica.

*Type*.—U.S.N.M. no. 50981.

*Remarks*.—Described from a unique specimen from the Wickham collection, collected April 1-4, 1906, by E. P. Van Duzee.

This species is allied to *pygmaeus* Fisher, but it differs from that species in being broader and more strongly flattened above, and in having the pronotum broader, and the elytra ornamented at the middle with a transverse, brown, pubescent fascia.

#### CYRTINUS ACUÑAL, new species

Very small, elongate, rather robust, strongly shining; head and pronotum greenish black, the former slightly aeneous in front; antennae black or dark reddish brown; elytra blackish blue, each with a large brownish yellow spot along lateral margin in front of middle, and a narrow, oblique fascia of the same color near apex; beneath dark reddish brown, except the prosternum, metasternum, mesosternum, and bases of femora, which are brownish yellow.

Head with the front strongly transverse, feebly convex, flat between the antennal tubercles, which are widely separated and scarcely elevated, with a vague, longitudinal groove extending from epistoma to occiput; surface densely, finely granulose, sparsely, feebly, finely punctate, sparsely clothed with long, flying, whitish hairs; eyes small, coarsely granulated, distinctly divided, separated from each other on the top by five times the width of the upper lobe, which is considerably smaller than the lower lobe. Antenna 11-jointed, about one-fourth longer than body, rather densely clothed with long, recumbent and erect, whitish hairs; first joint long, extending nearly to base of pronotum, gradually expanded toward apex, twice as long as third joint, which is slightly longer than the fourth, the following joints gradually decreasing in length.

Pronotum slightly longer than wide, distinctly narrower at base than at apex, widest near apex; sides feebly sinuate and expanded anteriorly, strongly constricted at basal fourth, then parallel to base; disk strongly convex anteriorly, narrowly, transversely flattened along base, with a narrow, transverse groove at basal fourth;

surface finely, densely granulose, feebly punctate, very sparsely clothed with moderately long, recumbent, whitish hairs, with a few longer, erect hairs intermixed.

Elytra twice as long as wide, subequal in width to pronotum near apex; sides nearly parallel, feebly, arcuately expanded behind middle, then arcuately narrowed to the tips, which are separately rather broadly rounded; disk strongly, transversely depressed on basal half, strongly convex posteriorly, each elytron armed with a distinct basal tubercle; surface coarsely, deeply, irregularly punctate, the punctures becoming obsolete toward apices, very sparsely clothed with long, fine, erect hairs, and irregularly ornamented on the brownish yellow areas with a few tufts of dense, moderately long, erect, snow-white hairs.

Abdomen beneath finely, very sparsely punctate, sparsely clothed with fine, semierect hairs; last segment broadly rounded at apex. Legs sparsely clothed with long, semierect hairs; femora strongly, abruptly clavate toward apices, the club scarcely flattened laterally.

Length, 2.5 mm; width, 0.8 mm.

*Type locality*.—Buenos Aires, Trinidad Mountains, Cuba.

*Type*.—U.S.N.M. no. 50982.

*Remarks*.—Described from a single specimen collected May 3, 1932, by J. Acuña (Cuba E. E. A. Ent. no. 9910).

This species is allied to *eugeniae* Fisher, but it differs from that species in being much larger, of a bluish or greenish black color, and in having the antenna longer than the body with the first joint extending nearly to the base of the pronotum, and each elytron ornamented with two yellowish brown spots and armed with a distinct basal tubercle.

#### SCIOCYRTINUS, new genus

Head not retractile, distant from anterior coxae, front vertical and transverse; mandibles short, acute at tips; antennal tubercles prominent; cheeks moderately long; palpi robust, labial palpus shorter than maxillary. Antenna 11-jointed, as long as body, not densely ciliate beneath, unarmed; first joint moderately long, slightly arcuate, subcylindrical, not cicatricose at apex, slightly longer than second and third joints united; third joint twice as long as second, distinctly shorter than fourth, the following joints subequal in length. Eyes small, divided. Pronotum cylindrical, longer than wide, unarmed at the sides, tuberculate on disk. Elytra wider than pronotum, elongate, strongly depressed on basal halves, each armed with a feeble, basal tubercle. Legs rather long, subequal in length; femora strongly pedunculate, the posterior pair shorter than the abdomen; intermediate tibiae grooved; tarsal claws simple, divaricate; anterior coxal cavities closed posteriorly; intermediate coxal cavities closed

externally. Prosternal process rather wide, flat, strongly expanded posteriorly. Metasternum wide, feebly declivous anteriorly. Body elongate, pubescent.

*Genotype*.—*Sciocyrtinus elongatus*, new species.

This genus belongs to the tribe Cyrtinini and is related to *Cyrtinus* LeConte, but it differs from that genus in having the disk of the pronotum distinctly tuberculate and the elytra strongly and abruptly depressed on their basal halves.

SCIOCYRTINUS ELONGATUS, new species

Strongly elongate, strongly convex, subopaque, dark reddish brown, the base and anterior margin of pronotum, basal halves of elytra, abdomen, sternum, and bases of femora, slightly paler.

Head with the front strongly transverse, slightly convex, broadly concave between the antennal tubercles, which are widely separated and rather strongly elevated, with a narrow, longitudinal groove on the vertex; surface densely, rather coarsely rugose, sparsely clothed with long, recumbent, brownish-yellow hairs; eyes separated from each other on the top by twice the width of the upper lobe. Antenna sparsely clothed with moderately long, recumbent and erect, whitish hairs, the hairs slightly denser on underside of joints.

Pronotum one-fourth longer than wide, subequal in width at base and apex; sides nearly parallel, sinuate, feebly constricted at apical fourth, more strongly constricted at basal fourth; disk strongly convex, feebly depressed anteriorly, strongly, transversely concave at basal fourth, armed with a strongly elevated, obtuse tubercle on middle of disk; surface rather coarsely, densely rugose, sparsely clothed with short, recumbent, yellowish and whitish hairs intermixed. Scutellum elongate triangular, narrowly rounded at apex, nearly glabrous.

Elytra twice as long as wide, slightly wider than pronotum; humeral angles nearly rectangular; sides parallel from base to behind middle, then obliquely narrowed to the tips, which are separately narrowly rounded; disk strongly convex posteriorly, abruptly declivous at the sides, strongly, abruptly depressed on basal halves, the posterior margin of the depression on each elytron extending from lateral declivity at basal third obliquely backward to the sutural margin at middle, and with a large, vague, basal tubercle; surface coarsely, densely, irregularly punctate, sparsely, irregularly clothed with moderately long, recumbent, whitish pubescence, which is denser and forms an oblique vitta on the posterior margin of the basal depression, and with numerous moderately long, erect, stiff, black setae or hairs on the apical halves.

Abdomen beneath strongly shining, feebly, sparsely punctate, sparsely clothed with long, fine, recumbent hairs; last segment broadly rounded or subtruncate at apex. Legs moderately clothed with short, recumbent, whitish hairs; femora strongly clavate, the club elongate and slightly flattened laterally.

Length, 4.25 mm; width, 1.25 mm.

*Type locality*.—Mandeville, Jamaica.

*Type*.—U.S.N.M. no. 50983.

*Remarks*.—Described from a single specimen from the Wickham collection, collected April 1-4, 1906, by E. P. Van Duzee.

ESSOSTRUTHA ROBERTO, new species

*Female*.—Elongate, subparallel, slightly flattened above; above dark brown, the elytra slightly paler at bases, the head, pronotum, and elytra ornamented with yellowish-white pubescent markings; legs uniformly pale brownish yellow.

Head with the front slightly transverse, slightly narrower above than beneath, nearly flat, feebly concave between the antennal tubercles, which are widely separated and feebly elevated; surface coarsely, sparsely punctate, the punctures nearly concealed by the pubescence, densely clothed with very short, dark brown hairs, with a few long, fine, erect hairs intermixed, and ornamented on the front and outer margins of the eyes with very dense, broad, recumbent, yellowish-white pubescence, the yellowish pubescence on the front inclosing a broad, transverse, brownish pubescent spot behind the epistoma; eyes large, finely granulated, nearly divided, separated from each other on the top by twice the width of the upper lobe. Antenna slightly longer than the body, uniformly dark brown, densely clothed with moderately long, recumbent, blackish hairs, and rather densely ciliate beneath with long, erect, blackish hairs.

Pronotum slightly wider than long, subequal in width at base and apex, widest at middle; sides nearly parallel, slightly sinuate, feebly expanded at middle; disk regularly convex, feebly tumid at middle, feebly, broadly, transversely depressed along base; surface coarsely, sparsely punctate, densely clothed with very short, dark brown hairs, with a few long, erect hairs intermixed, and ornamented on each side of middle with a large, broad, irregular, transverse spot of very dense, broad, recumbent, yellowish white pubescence. Scutellum strongly transverse, broadly rounded or subtruncate at apex.

Elytra three and one-half times as long as pronotum, at base distinctly wider than pronotum; humeri strongly developed; sides slightly narrowed from base to apical sixth, then arcuately rounded to the tips, which are separately feebly emarginate; disk slightly



flattened; surface sparsely, coarsely, irregularly punctate, densely clothed with very short, recumbent, dark brown hairs, with a few long, erect hairs intermixed, each elytron ornamented with very dense, broad, recumbent, yellowish white pubescence as follows: An elongate spot along sutural margin behind scutellum; a broad, transversely arcuate fascia just in front of middle; and an irregular, transverse spot at apical fourth, not extending to lateral or sutural margins.

Body beneath densely clothed with moderately long, semierect, reddish pubescence, with a few long, erect hairs intermixed, the metasternum and mesosternum ornamented on each side with a large, yellowish white pubescent spot; last abdominal segment feebly, broadly, arcuately emarginate at apex; legs rather densely clothed with moderately long, recumbent, golden yellow hairs, with a few longer, erect hairs intermixed.

*Male*.—Differs from the female in having the eyes more narrowly separated on top of the head, and the elytra more strongly narrowed posteriorly.

Length, 8.25–11.5 mm; width, 2.5–3.75 mm.

*Type locality*.—Los Animas, Sierra Rangel, Cuba.

*Type*.—U.S.N.M. no. 50984.

*Paratype*.—In S. C. Bruner collection.

*Remarks*.—Described from two specimens (female type) collected at the type locality at an elevation of 1,500 feet, during May 1933, by Hermano Roberto of the La Salle College at Habana (Cuba E. E. A. Ent. no. 10105).

This species is allied to *ramsdeni* Fisher, but it differs from that species in having the upper surface of the body ornamented with yellow-white pubescent markings.

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TWO NEW SPECIES OF TAPEWORMS FROM CARNIVORES  
AND A REDESCRIPTION OF *TAENIA LATICOLLIS*  
RUDOLPHI, 1819

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IN STUDYING a collection of cestodes from carnivores in North America, I found two species with characters sufficiently distinctive to necessitate considering them new.

A review of specific characters develops the fact that hook sizes as given in the literature are not necessarily comparable things. No scheme for measuring hooks appears to be generally accepted by the various writers on cestodes, but in this paper I assume, where no scheme such as Meggitt's (1927, p. 420) is presented, that the length of the entire hook is the distance, in a straight line, from tip to tip; that the length of the blade is the distance, in a straight line, from the tip of the blade to the tip of the guard; and that the length of the handle is the distance, in a straight line, from the tip of the handle to the tip of the guard. The length of the guard is perhaps usually considered the distance from the tip of the guard to the dorsal edge of the hook. In this paper the different types of hooks have made it advisable to use more than one scheme for measurement. The scheme used for *Taenia lyncis* is represented in plate 19, figure 4. AB represents length of hook, DB length of blade, AC length of handle, and EF length of guard. This scheme is also followed in measuring the hooks of *T. tawidiensis*. The hooks

of *T. laticollis* are measured according to the scheme referred to above as the one believed to be in general use. All these terms used in discussions of hooks invite criticism, especially such a name as "dorsal edge", for hooks cannot accurately be said to have a "dorsal" edge, but these terms are retained in preference to introducing a new terminology.

TAENIA LYNCEIS, new species

PLATE 19, FIGURES 2-5; PLATE 20, FIGURES 1-4

*Specific diagnosis.*—Length up to about 64 cm, maximum width 11 mm. Genital papillae inconspicuous, located approximately in middle of lateral margin of segment. Overlapping of segments not pronounced. Mature segments comparatively few, usually 10 to 15; gravid segments constituting more than half of length of strobila. Neck usually short; segmentation usually beginning  $540\mu$  to 1.4 mm posterior to suckers. Scolex usually wider than first segments,  $620\mu$  to 1 mm wide; suckers conspicuous, round, or slightly oblong with greater diameter in anteroposterior direction,  $165\mu$  to  $205\mu$  in diameter; rostellum  $250\mu$  to  $400\mu$  in diameter, armed with double crown of 36 to 46 hooks, rostellum sometimes protruding to an extent one and a half times as long as remainder of scolex. Large hooks  $220\mu$  to  $258\mu$  long (pl. 19, fig. 5); handle  $110\mu$  to  $151\mu$  long, widest portion at distal end; guard conspicuous,  $55\mu$  to  $70\mu$  long; blade  $79\mu$  to  $85\mu$  long. Small hooks  $159\mu$  to  $208\mu$  long; guard distinctly bifid (pl. 19, fig. 3),  $43\mu$  to  $63\mu$  long; handle  $79\mu$  to  $122\mu$  long; blade  $61\mu$  to  $73\mu$  long. Nerve cord about  $600\mu$  from lateral margin of segment; ventral longitudinal canal  $700\mu$  to  $800\mu$  from lateral margin of segment; posterior transverse canal conspicuous. Calcareous corpuscles spherical or ovoid, about  $22\mu$  in greater diameter.

Type specimen 23 cm long; maximum width 4.5 mm; about 236 segments; all segments wider than long; terminal gravid segments about 2.75 mm long, 3.5 mm wide. Segmentation apparent  $750\mu$  to 1 mm posterior to suckers; genital primordia visible in about fifteenth segment. The strobilae of various specimens vary widely in general appearance; in the type and a paratype (U.S.N.M. no. 28482) the strobila is thin; in some other paratypes (U.S.N.M. no. 26886) it is uniformly much wider and thicker, and would thus suggest that it is a distinct species, but the hooks and the anatomy of the mature segment check satisfactorily with the type specimen. The mature segments illustrated in plate 20, figure 3, are from a worm about 60 cm long from *Felis concolor hippolestes* and are quite unlike those of the type specimen in other ways than in the size of the strobilae (that is, in the shape and size of the ovary and vitel-

larium and in the number of testes), but the hooks are sufficiently like those of the type specimen to leave no doubt concerning the specific determination of this worm. Other strobilae collected from the same host show in some of the mature segments much greater similarity to the type specimen than do those that were photographed, but the condition of the material did not provide segments suitable for photographing. The strobila of this larger worm appears to have been stretched in fixation, and this probably accounts for the distance between the vitellarium and the posterior margin of the segment as contrasted with the position of the vitellarium in the type specimen.

*Male reproductive system.*—Testes usually<sup>1</sup> spherical, sometimes slightly elongated,  $30\mu$  to  $50\mu$  in greater diameter in typical segments, 200 to 500 in number, with usual distribution between longitudinal canals, not closely crowded in typical segment; usually a few testes in space between ovaries and vitellarium; testes usually overlap lateral portions of vitellarium; usually several testes posterior to vitellarium, only rarely a few posterior to ovary. In plate 20, figure 2, are shown segments of a strobila in which testes are  $60\mu$  to  $95\mu$  in diameter and somewhat more crowded together. Seminal vesicle not observed. Coiled mass of vas deferens passing in an approximately straight line from cirrus pouch toward center of segment. Cirrus pouch  $200\mu$  to  $375\mu$  long,  $70\mu$  to  $110\mu$  wide, rarely extending mediad to ventral longitudinal excretory canal.

*Female reproductive system.*—Ovaries varying somewhat in shape, depending on state of contraction; typical shape of ovary is that shown in plate 20, figure 2; each lobe wider (measured along transverse axis of strobila) than long. Vitellarium usually of shape shown in plate 20, figure 2, occasionally triangular, usually not extending laterad beyond lobes of ovary, about 1.5 mm wide as measured along transverse axis of strobila and about  $120\mu$  long as meas-

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<sup>1</sup>The description of this species is based on the study of specimens collected over a period of many years and therefore represents a far more extensive consideration of variation than is commonly included in the original description of a species. To one not wholly familiar with the usual variations found in cestodes, such a study has its disadvantages, for when one recognizes and tabulates variations resulting from different stages of contraction and expansion (due usually to methods and media of fixation), from the age of the specimens, from the size and state of nutrition of the host animal, or from the multitude of undetermined factors (possibly the hereditary composite due to the genes) that are accepted as playing a part in determining the physical characteristics of any organism, it becomes difficult to set down concise statements concerning characters that may be found in all specimens; as a result the description lacks a pleasing exactness that might be given to it if no note were made of these variations or if several additional species were made on the basis of such variation. My study of cestodes has led me to take the position that in many descriptions what has been designated as specific differences is no more than these individual variations, and with the resulting latitude given to my conception of a species the frequent use of limiting adverbs such as "usually" becomes unavoidable.

ured along longitudinal axis of strobila. Vagina posterior to cirrus pouch, lined with ciliated cells; seminal receptacle variable in size,  $125\mu$  to  $170\mu$  long and  $50\mu$  to  $61\mu$  wide. The structure considered herein as the so-called shell gland is relatively inconspicuous,  $30\mu$  to  $60\mu$  in diameter. Uterus at first an approximately straight tube, later developing wide outpocketings, these becoming reduced to more delicate lateral branches, 4 to 10 (frequently 8) in number on each side; uterine branches sometimes (pl. 19, fig. 2) taking on the appearance of "drooping" branches. Eggs about  $25\mu$  by  $28\mu$  to  $35\mu$ .

*Larva* with large terminal bulblike bladder about 8 mm long and 6.5 mm wide, transversely striated (pl. 20, fig. 4); body of larva about 11 mm long and 2.5 mm in maximum width.

*Hosts*.—Definitive: *Lynx rufus rufus*, *L. r. californicus*, *L. r. fasciatus*, *L. r. vinta*, *Felis concolor azteca*, *F. c. hippolestes*, *F. c. oregonensis*; intermediate: *Odocoileus columbianus scaphiatus*, *O. hemionus hemionus*, and *O. virginianus macrourus*.

*Location*.—Small intestines of definitive host; lungs and pericardium of intermediate host.

*Distribution*.—United States (Arizona, California, Colorado, Idaho, Minnesota, Montana, New Mexico, North Carolina, Oregon, Utah, Virginia, and Washington).

*Life history*.—The hooks of larval forms found in *Odocoileus columbianus scaphiatus*, *O. hemionus*, and *O. virginianus* are similar to those of the adult cestode. While experimental evidence as to the life history is lacking, the shape and size of these hooks appear to constitute a specific character, and this morphological character suggests that these larvae found in the deer develop to an adult form in the carnivores listed as definitive hosts when infested deer are eaten by these carnivores. The deer presumably become infested by ingesting the eggs in contaminated food or water.

Cysticerci attached to the liver of *Peromyscus maniculatus nubriterrae* from Sevier County, Tenn., show hooks similar to those of *Taenia lyncis* in shape and size. Both the host and the location of these cysticerci indicate that evidence based upon successful experiments with the life history of this worm is needed before a specific determination can be made. These specimens were collected by E. V. Komarek, of Thomasville, Ga.

The hooks, especially the small ones, which are unlike those of other carnivore cestodes known to me, on account of their long tapering handle and long bifid guard serve as the best character for specific determination. This species has frequently been found in the same host with *Taenia macrocystis*.

*Type specimen*.—U.S.N.M. no. 39801, collected from *Lynx rufus* in Alleghany County, Va., by Dr. E. W. Price, of the U. S. Bureau of Animal Industry; paratypes (no. 28482) also collected by Dr. Price.

**TAENIA TAXIDIENSIS, new species**

PLATE 19. FIGURES 9-12; PLATE 21

*Specific diagnosis*.—Type specimen about 10 cm long; maximum width about 2 mm; about 150 segments (100 immature, 30 mature, 20 gravid). Neck relatively long; first segmentation apparent about 3 mm posterior to suckers; genital primordia visible in about twentieth segment. Genital papillae usually in middle of lateral margin of segment or slightly anterior to middle, sometimes quite prominent and occupying one-fourth length of segment margin. Scolex (pl. 19, fig. 12) only slightly wider than anterior portion of neck, about  $450\mu$  in greatest diameter; suckers prominent, cuplike, about  $140\mu$  in diameter; rostellum about  $170\mu$  in diameter. Hooks (pl. 19, fig. 9) incompletely known; only one type (presumably large hooks) present on available material; length of hooks  $90\mu$  to  $93\mu$ ; handle about  $56\mu$  long; guard  $44\mu$  to  $47\mu$  long; width of guard about  $16\mu$ . Hooks appeared to be easily lost; the one hook found on the type specimen was lost during the mounting process. Longitudinal excretory canals inconspicuous, difficult to trace even in cross sections. Calcareous corpuscles round or ovoid, up to  $15\mu$  in greater diameter.

One complete (?) specimen and several fragments comprise the type and paratype material.

*Male reproductive system*.—Testes 150 to 250 in number, in one layer dorsoventrally, usually spherical, sometimes ovoid, about  $31\mu$  in greater diameter, with the usual distribution between longitudinal canals. No testes observed posterior to vitellarium and none between lobes of ovary. Coiled mass of vas deferens conspicuous, usually curving somewhat toward posterior margin of segment in its course toward median region of segment. Cirrus pouch extending mediad to inner margin of ventral excretory vessel.

*Female reproductive system*.—Ovaries and vitellarium vary widely in shape and size, as shown by camera lucida diagrams, all drawn to same scale, in plate 21. Vitellarium relatively conspicuous, not extending laterally beyond ovary, usually close to posterior margin of segment. Shell gland not demonstrable. Gravid uterus (pl. 19, fig. 11) with 11 to 19 lateral branches on each side. Eggs not observed.

*Hosts*.—Definitive: *Taxidea taxus taxus*; intermediate: Unknown.

*Location*.—Intestine of definitive host.

*Distribution*.—United States (Granite County, Mont.).

*Life history*.—Unknown.

*Type specimen*.—U.S.N.M. no. 39803; paratypes, no. 32840; all collected by W. L. Jellison, of the University of Montana.

The condition of the type specimen and of the few additional paratype fragments available makes adequate description of a number of details impossible, but the size and shape of the hooks, especially the conspicuously long guard, constitute a character adequate for specific determination.

TAENIA LATICOLLIS Rudolphi, 1819

PLATE 19, FIGURES 1, 6-8

*Specific diagnosis*.—Length up to 14 cm, maximum width 3.2 mm. Immature segments usually wider than long; mature segments usually approximately square; gravid segments usually longer than wide. Neck usually distinct, sometimes obscured by contraction, usually slightly narrower than greatest diameter of scolex. Genital papillae only moderately prominent, located approximately in middle of segment margin. Suckers usually prominent, rostellum usually prominent, about  $700\mu$  in diameter, with double circlet of 38 to 42 hooks; large hooks  $390\mu$  to  $415\mu$  long; hook  $400\mu$  long with handle  $195\mu$  long, blade  $146\mu$  long, guard  $73\mu$  long; small hooks  $214\mu$  to  $238\mu$  long, handle  $122\mu$  to  $134\mu$  long, blade  $134\mu$  to  $140\mu$  long; guard only slightly bifid. Ventral longitudinal excretory canals only moderately prominent, varying widely in shape and size, up to  $125\mu$  in diameter when circular in cross sections; no other longitudinal canals demonstrable. Transverse excretory canal conspicuous, up to  $230\mu$  in diameter.

One specimen examined was 83 mm long and 2.5 mm in maximum width; about 90 segments (62 immature, 10 mature, 18 gravid); first segmentation apparent about 1.4 mm posterior to suckers; genital primordia visible in twentieth to twenty-fifth segments. Scolex 1.5 mm in diameter; suckers  $390\mu$  in diameter, rostellum  $714\mu$  in diameter.

*Male reproductive system*.—Testes approximately globular,  $37\mu$  to  $49\mu$  in diameter, 180 to 250 in number, with usual distribution between longitudinal canals. No testes observed posterior to vitellarium or between lobes of ovary. Vas deferens (pl. 19, fig. 7) usually loosely coiled, conspicuous, sometimes occupying entire medullary parenchyma from cirrus pouch to median field of segment, usually curved somewhat anteriorly in median field of segment, usually extending to center of segment. Cirrus pouch  $275\mu$  to  $293\mu$  long by  $66\mu$  to  $131\mu$  wide, extending to longitudinal canals.

*Female reproductive system*.—Ovaries with aporal lobe usually larger, about  $360\mu$  long by  $180\mu$  wide, poral lobe about  $295\mu$  long by  $180\mu$  wide. Vitellarium wedge-shaped,  $595\mu$  to  $655\mu$  wide (measured along transverse axis of strobila) by  $60\mu$  to  $120\mu$  long, usually extend-

ing laterad beyond ovaries. Uterus with 10 to 15 lateral branches on each side. Eggs  $40\mu$  by  $28\mu$  to  $32\mu$ .

*Hosts*.—Definitive: *Lynx fasciatus*, *L. f. fasciatus*, *L. rufus*, *L. r. californicus*, *Lynx lynx* (syn. *Felis lynx*), *Canis lestes*; intermediate: Unknown.

*Location*.—Intestine of definitive host.

*Distribution*.—Europe and United States (Washington and California).

*Life history*.—Unknown.

*Remarks*.—This redescription is based upon U.S.N.M. no. 25317 and other specimens filed in the Zoological Division, Bureau of Animal Industry.

In several respects this species is similar to *T. taeniaeformis*, and the two species have undoubtedly been confused; in both species the rostellum is relatively heavy and conspicuous, sometimes extended to a length exceeding that of the scolex; the suckers also are relatively prominent and the hooks relatively large. Nevertheless, the two species are readily separated, by even casual examination, on the basis of the difference in the shape of the large hooks and the striking difference in the size of the strobila in mature specimens; the guard of the hooks of *T. taeniaeformis* is much more prominent than the guard of the large hooks of *T. laticollis*; the strobila of *T. taeniaeformis* is usually much longer and wider than that of *T. laticollis*. It is also probable that *T. laticollis* has been confused with *T. macrocystis*; both species are relatively small cestodes and both have relatively large hooks, but the hooks of *T. macrocystis* are more numerous and the large hooks especially are quite unlike those of *T. laticollis* in shape and size; the maximum length of the large hooks of *T. macrocystis* is less than the minimum length recorded for those of *T. laticollis*.

The size and shape of the hooks and the conspicuous vas deferens, with its mass of coils usually extending to the median field of the segment and curving somewhat anteriorly, are the two most outstanding characters for differentiation of this species from other members of the genus.

Hall (1919) gave a compilation (see table 1) of the descriptions of *T. laticollis* from several authors, including Leuckart (1856). Hall's compilation gave the large hooks as "(?) 380 to  $420\mu$  long" and the small hooks as "150 (?) to  $183\mu$  long"; Leuckart figured them on the same scale as and in the same plate with *T. crassicollis* (= *T. taeniaeformis*) and described them as the same size as those of *Taenia crassicollis* but slenderer and somewhat more curved ("gerummt"). The large hooks of *T. laticollis* must then be considered recorded by Leuckart as  $390\mu$  (the length recorded by him



for the large hooks of *T. crassicollis*), but I find the length of the large hooks of *T. taeniaeformis* (syn., *T. crassicollis*) to be  $380\mu$  to  $430\mu$ ; therefore the large hooks of *T. laticollis* as estimated from Leuckart's description may be considered to be approximately  $380\mu$  to  $430\mu$  long. For the small hooks of *T. laticollis* Leuckart gave the length from the tip of the handle to the tip of the guard as  $128\mu$  and the distance from the tip of the blade to the tip of the guard as only slightly more than the length of the handle (or more than  $128\mu$ ). This provides a basis for determining Leuckart's estimate of the length of the short hooks of *T. laticollis*, but they may also be compared with the small hooks of *T. taeniaeformis*, which I find to be  $238\mu$  to  $260\mu$  long, and these measurements may be taken to represent approximately the length of the small hooks of *T. laticollis* according to Leuckart's description. The length of the short hooks of *T. laticollis*, as estimated from Leuckart's description, is then somewhat more than that given by me, while the measurement I give for the large hooks agrees with that given by Leuckart. One other point of difference remains—the relative length of the blade and handle in the large hooks as described and figured by Leuckart and by me. From Leuckart's description and figures the distance from the tip of the guard to the tip of the handles is found to be  $239\mu$  and the distance from the tip of the guard to the tip of the blade to be slightly longer than  $239\mu$ . In the hooks described by me, the length of the blade, measured as Leuckart measured it, is found to be less than the length of the handle. This difference leaves grounds for contending that the two species are not identical. However, in spite of this difference and the slight difference in the length of the small hooks, I conclude that the specimens that I examined from lynxes in North America are *T. laticollis*.

TABLE 1.—*Descriptive data on Taenia laticollis Rudolphi, 1819*

Character	Hall's compilation (1919)	Leuckart's description (1856)	Skinker
Length.....	50 to 95 mm.....	95 mm.....	Up to 140 mm.
Maximum width.....	2 mm.....	2 mm.....	3.2 mm.
Neck.....	Absent.....	Absent.....	Present or absent according to state of contraction. <sup>1</sup>
Scolex (diameter).....	1 to 1.22 mm.....	.....	About 1.5 mm.
Rostellum (diameter).....	600 $\mu$ to 700 $\mu$ .....	700 $\mu$ .....	About 714 $\mu$ .
Suckers (diameter).....	340 $\mu$ to 400 $\mu$ .....	.....	About 390 $\mu$ .
Hooks (total number).....	38 to 60.....	60.....	38 to 42.
Small hooks (length).....	150 (?) to 183 $\mu$ .....	About 250 $\mu$ <sup>2</sup> .....	214 $\mu$ to 238 $\mu$ .
Small hooks (distance from tip of handle to tip of guard).....	.....	128 $\mu$ .....	122 $\mu$ to 134 $\mu$ .
Small hooks (distance from tip of guard to tip of blade).....	.....	Slightly more than 128 $\mu$ .....	134 $\mu$ to 140 $\mu$ .
Large hooks (length).....	380 to 420 $\mu$ .....	About 390 <sup>2</sup> .....	390 $\mu$ to 415 $\mu$ .
Large hooks (distance from tip of handle to tip of guard).....	.....	239 $\mu$ .....	195 $\mu$ to 244 $\mu$ .
Large hooks (distance from tip of guard to tip of blade).....	.....	Slightly more than 239 $\mu$ .....	146 $\mu$ to 177 $\mu$ . <sup>3</sup>
Genital papillae.....	Prominent.....	.....	Only moderately prominent.
Longitudinal excretory canals.....	.....	.....	Not prominent.
Testes (number).....	.....	.....	About 180 to 250.
Testes (diameter).....	.....	.....	37 $\mu$ to 49 $\mu$ .
Eggs.....	.....	Not observed.....	28 $\mu$ to 32 $\mu$ by 40 $\mu$ .
Hosts (definitive).....	<i>Lynx lynx</i> (syn., <i>Felis lynx</i> ), <i>L. canadensis</i> . <sup>3</sup>	The lynx.....	<i>Lynx fasciatus</i> , <i>L. f. fasciatus</i> , <i>L. rufus</i> , <i>L. r. californicus</i> .
Locality.....	Europe and (?) U. S. ....	Europe.....	North America (Wash. and Calif.)
Larva.....	Unknown.....	Unknown.....	Unknown.
Drawings.....	Small hooks, after Lühe (1910).	Large hooks and small hooks.	Hooks, mature segment, gravid segment.

<sup>1</sup> Observations made by me on many specimens of cestodes indicate that the presence or absence of the neck in any taenioid cestode is dependent upon the state of contraction of the strobila as a whole. In *T. taeniaeformis*, a species described by most authors as being without a neck, I find a distinct neck in all uncontracted specimens.

<sup>2</sup> See discussion of measurement of hooks given in the general discussion of this species (p. 217).

<sup>3</sup> Hall (1919) included *Lynx canadensis* in the list of hosts of *T. laticollis*. This record is undoubtedly based on a record published by Stiles and Hassall (1894), but examination of this material by me reveals that the specimens, which were collected by Dr. A. I. Comfort, were incorrectly determined and are *T. macrocystis*; no other information concerning them is available. Therefore *Lynx canadensis* cannot at present be said to be known to serve as a host for *T. laticollis*, although several other members of the genus *Lynx* are known to serve as hosts, and it is therefore probable that *L. canadensis* will in time be found to harbor this cestode.

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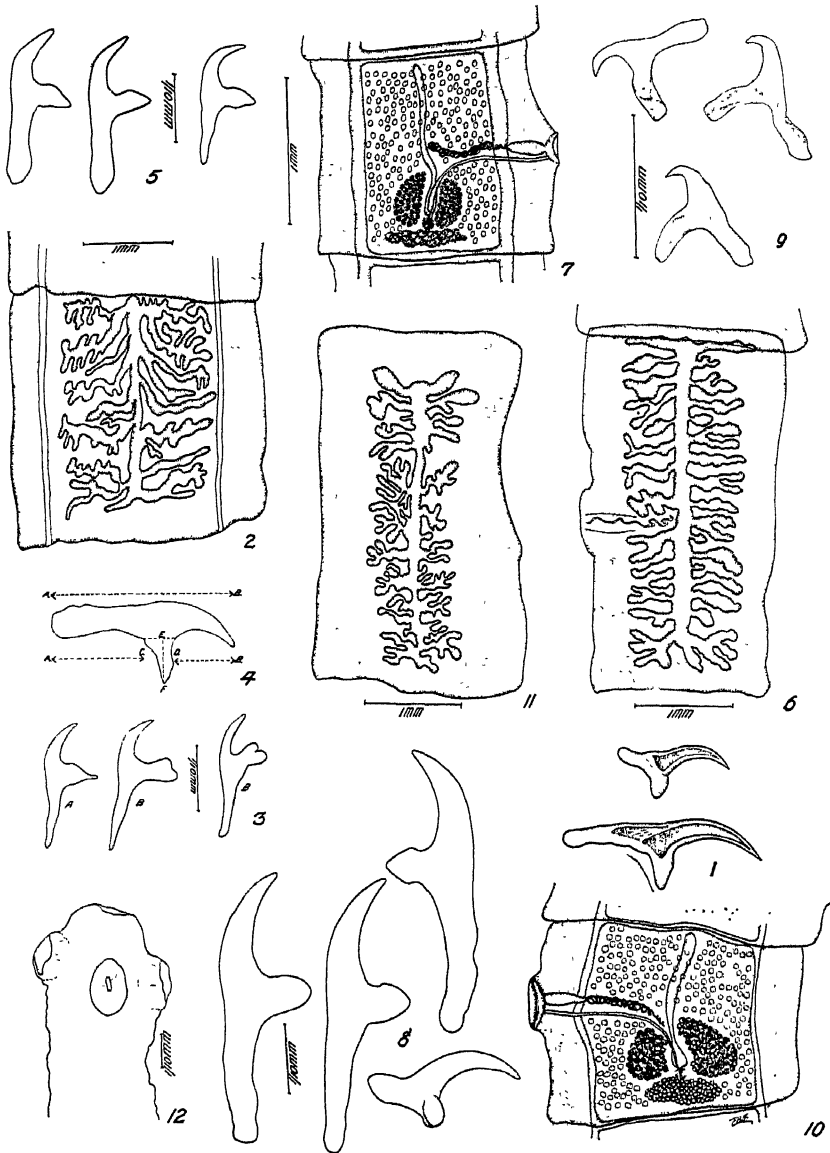
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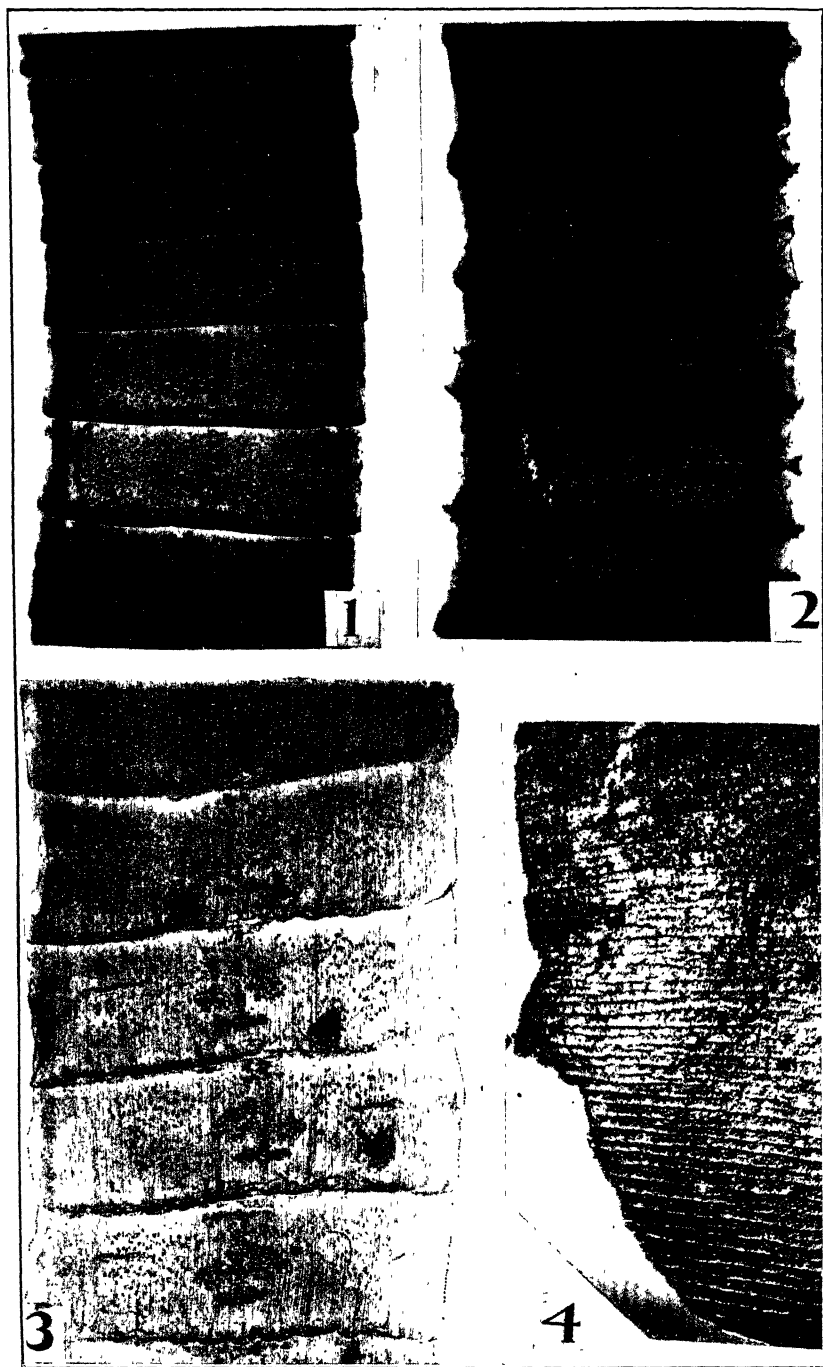


1. Hooks of *Taenia laticollis*. Enlarged. (After Leuckart, 1856)

2-5. *Taenia lyncis*: 2, Gravid segment; 3, small hooks showing bifid condition (a, hook turned at an angle; b, hooks flattened by pressing on cover glass); 4, diagram of hook indicating scheme for giving measurement of hooks; 5, lateral view of large hooks and of small hook

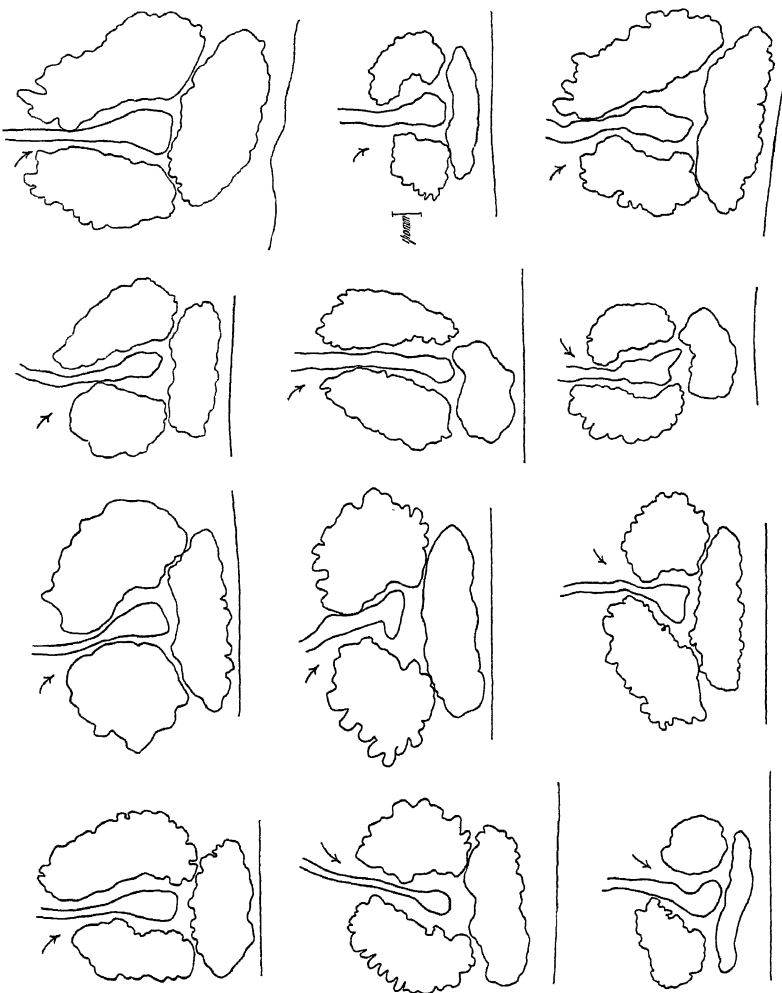
6-8. *Taenia laticollis*: 6, Gravid segment; 7, mature segment; 8, hooks.

9-12. *Taenia taridiensis*: 9, Hooks; 10, mature segment; 11, gravid segment; 12, scolex.



## TAENIA LYNCSIS, NEW SPECIES.

1, Mature segments of type specimen,  $\times 20$ ; 2, mature segments,  $\times 20$ ; 3, mature segments from *Felisconcolor hippolestes*,  $\times 20$ , 4, portion of body wall showing striations,  $\times 30$ .



Camera lucida diagrams of the ovary and vitellarium of *Tuenia luridensis*, all drawn to same scale. Posterior margin of segment drawn in part. Poral lobe of ovary indicated by arrow.





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## NEW PALEOCENE MAMMALS FROM THE FORT UNION OF MONTANA

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IN 1901, Earl Douglass, working for Princeton University, discovered and collected mammal remains in the Fort Union Group east of the Crazy Mountains in central Montana, and Princeton expeditions under Dr. M. S. Farr also made small collections in 1902 and 1903. A. C. Silberling, now of Harlowton, Mont., accompanied these expeditions, and ever since then he has continued to collect in this field. Some of his earlier material went to the Carnegie Museum, and recently some has been acquired by the American Museum of Natural History, but most of it is in the United States National Museum. The largest collections were made by him from 1908 to 1911, under grants from the United States Geological Survey and the National Museum. The result is one of the richest, most varied, and most important Paleocene mammal collections ever made.

The late Dr. James W. Gidley, assistant curator of fossil mammals in the National Museum, visited the field in 1909. Concurrently with his other duties and interests, Dr. Gidley set about the long task of preparing the specimens in the National Museum, and essentially completed it in 1920. He published four papers based on or including part of this material,<sup>1</sup> and he planned to publish a memoir

<sup>1</sup> Notes on the fossil mammalian genus *Ptilodus*, with descriptions of new species. Proc. U. S. Nat. Mus. vol. 36, pp. 611-626, 1909.

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New species of claeodonts from the Fort Union (Basal Eocene) of Montana. Bull. Amer. Mus. Nat. Hist., vol. 41, pp. 541-555, 1919.

Paleocene primates of the Fort Union, with discussion of relationships of Eocene primates. Proc. U. S. Nat. Mus., vol. 63, art. 1, pp. 1-38, 1923.



of the whole fauna, but this hope was still unfulfilled at the time of his death in 1931. In 1932, Dr. Alexander Wetmore and C. W. Gilmore, of the National Museum, invited me to carry out Dr. Gidley's plan and to write the proposed memoir, an invitation gratefully accepted as an opportunity for useful work and for a most fitting and practical tribute to the memory of a friend and colleague. The American Museum has permitted the use of my time as a cooperative undertaking with the National Museum.

This study and the even slower preparation of the illustrations are now well advanced, but it will be at least a year and possibly several before it can be published. In the meantime, it seems necessary to facilitate the work of others and the study of the Paleocene in general by publishing names and brief diagnoses of the new genera and species so far recognized. Those studied are here published, and possibly some others may appear in similar preliminary form before the entire memoir is published. Full descriptions, discussions of affinities, and illustrations will appear in the memoir.

Aside from a few records and notes for his published papers, Dr. Gidley left 27 sheets of manuscript in various stages of preparation, in part duplicated or different drafts of the same subject. These limited notes were evidently prepared over a long period, all some time ago, and they probably do not express Dr. Gidley's definitive opinions. In studying the collection, I have first examined the specimens independently and then have ascertained whether new genera or species recognized by me are named and defined in Gidley's notes. In several cases they are (and in these instances I publish the names as of Gidley, *ex ms.*, quoting his diagnosis and, if necessary, following it by an emended diagnosis by me). This will, I hope, make the work unified and abreast of recent knowledge, and at the same time will give Dr. Gidley proper credit for the discoveries that he had reduced to paper. In a few other cases there are notations on labels that specimens represent new species, but with no manuscript name or diagnosis. Of these (so far as I agree that the species are new) I am forced to assume authorship, but I also record their recognition by Dr. Gidley.

Following is a list of the mammals so far recognized in the Fort Union of the Crazy Mountain Field. It includes 40 genera (15 new herein) and 57 species (37 new). Even this large list does not fully represent the variety actually present, for there are numerous species not yet adequately studied. Most of the listed mammals are from the Gidley and Silberling Quarries, but some are from markedly different levels, although all appear to be Middle Paleocene. Exact distributional data are available and will be published later.

## Order MULTITUBerculata:

## Ptilodontidae:

*Ptilodus montanus* Douglass, 1908.

*Ptilodus douglassi*, new species.

*Ptilodus gidleyi*, new species.

*Ptilodus sinclairi*, new species.

*Ectypodus grangeri*, new species.

*Ectypodus russelli*, new species.

*Ectypodus silberlingi*, new species.

*Paractypodus jepseni*, new species.

*Eucosmodon* sp.

## Order INSECTIVORA:

## ?Deltatheridiidae:

*Gelastops parvus*, new genus and species.

## Leptictidae:

*Myrmecoboides montanensis* Gidley, 1915.

*Prodiacodon concordiacensis*, new species.

*Leptacodon ladae*, new species.

*Leptacodon munusculum*, new species.

*Emperodon acmeodontoides*, new genus and species.

## Nyctitheriidae:

*Stilpnodon simplicidens*, new genus and species.

## Pantolestidae:

*Aphronorus fraudator*, new genus and species.

*Palaeosinopa diluculi*, new species.

## Mixodectidae:

*Eudaemonema cuspidata*, new genus and species.

## Order PRIMATES:

## Plesiadapidae:

*Pronothodectes matthewi* Gidley, 1923.

## Carpolestidae:

*Elphidotarsius florencae* Gidley, 1923.

## ?Anaptomorphidae:

*Paromomys maturus* Gidley, 1923.

*Paromomys depressidens* Gidley, 1923.

*Palaeochthon alticuspis* Gidley, 1923.

*Palenochtha minor* (Gidley, 1923), new genus

## Order TAENIODONTA:

## Stylinodontidae:

*Conoryctes comma* Cope, 1881.

*Psittacotherium multifragum* Cope, 1882.

## Order CARNIVORA:

## Arctocyoniidae:

*Claenodon ferox* (Cope, 1883).

*Claenodon montanensis* (Gidley, 1919).

*Claenodon silberlingi* (Gidley, 1919).

*Claenodon latidens* (Gidley, 1919).

*Claenodon vecordensis*, new species.

*Deuteronodon montanus*, new genus (Simpson) and species (Gidley).

*Prothryplacodon furens*, new genus and species.

*Chriacus pusillus*, new species.

*Chriacus pugnax*, new species.

*Metachriacus punitor*, new genus and species.

## Order CARNIVORA—Continued.

## Arctocyoniidae—Continued.

*Metachriacus provocator*, new species.

*Spanoxyodon latrunculus*, new genus and species.

*Tricentes latidens*, new species (Gidley).

*Coriphagus montanus* Douglass, 1908.

## Miacidae:

*Itidopappus mustelinus*, new genus and species.

*Didymictis tenuis*, new species.

*Didymictis microlestes*, new species.

*Didymictis haydenianus* Cope, 1882.

## Order CONDYLARTHERA:

## Phenacodontidae:

*Tetraclaenodon symbolicus*, new species (Gidley).

?*Tetraclaenodon superior*, new species.

*Gidleyina montanensis*, new genus (Simpson) and species (Gidley).

?*Gidleyina silberlingi*, new species (Gidley).

## Hyopsodontidae:

*Ellipsodon aquilonius*, new species.

*Litaletes disjunctus*, new genus and species.

*Litomylus dissentaneus*, new genus and species.

*Haplaletes disceptatrix*, new genus and species.

## Order AMBLYPODA:

## Pantolambdidae:

*Pantolambda intermedius*, new species.

*Pantolambda* cf. *cavirictus* Cope, 1883.

## Periptychidae:

*Anisonchus sectorius* (Cope, 1881).

## INCERTAE SEDIS:

*Picrodus silberlingi* Douglass, 1908.

*Megopterna minuta* Douglass, 1908.

## Order MULTITUBERCULATA

## Family PTILODONTIDAE

Ptilodontids are very abundant and surprisingly varied in the collection. After prolonged analysis, which cannot be published here, eight sharply distinct species are definable and at least one other is represented by fragmentary specimens. Although the species are readily distinguishable from one another and from all others known, their generic assignment is uncertain in every case but one. There are five named genera of ptilodontids in the American Paleocene, and some of these species almost certainly belong to new genera, but these cannot now be defined. It is usually impossible to be sure of a generic assignment without associated incisors, last lower premolars, and last upper premolars, which are not available for seven of the eight species in the collection. Generic assignments are thus made with a query on an insecure basis of general resemblance, and the definitions distinguish the species from all known ptilodontids and not merely from those of the genus to which each is referred. Far the most abundant

species is *Ptilodus montanus* Douglass, 1908, with which I find *Ptilodus gracilis* Gidley, 1909, to be synonymous.<sup>2</sup> The other seven species are new and are diagnosed below. They are named for students and collectors of the American Paleocene.

### Genus *PTILODUS* Cope

#### ?*PTILODUS DOUGLASSI*,<sup>3</sup> new species

*Type*.—U.S.N.M. no. 9795, right lower jaw with  $P_4$ – $M_2$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry (and referred specimens from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Structurally similar to *P. montanus*, but  $P_4$  and  $M_2$  significantly smaller both absolutely and in relation to  $M_1$ . Length of  $P_4$  (mean of 3 specimens) 6.6 mm. Length of  $M_1$  (type) 3.7 mm. Length of  $M_2$  (type) 2 mm. Ratio length  $P_4$ : length  $M_1$  (type) 1.8. Ratio length  $M_1$ : length  $M_2$  (type) 1.8. Serrations of  $P_4$  13 in known specimens.

#### ?*PTILODUS GIDLEYI*,<sup>4</sup> new species

*Type*.—U.S.N.M. no. 9763, left lower jaw with  $P_4$  and broken  $M_1$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Close to *P. montanus* in proportions and structure, but  $P_4$  and  $M_1$  significantly smaller.  $M_1$  significantly smaller relative to  $P_4$  than in *P. trovessartianus* or ?*P. douglassi*. Length  $P_4$  6.1 mm (to 5.9 in referred specimen). Length  $M_1$  2.5 mm. Ratio length  $P_4$ : length  $M_1$  2.4. Serrations of  $P_4$  14 in known specimens.

#### ?*PTILODUS SINCLAIRI*,<sup>5</sup> new species

*Type*.—U.S.N.M. no. 9770, left lower jaw with  $P_4$ – $M_2$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry (and referred specimens from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Significantly smaller than any possibly related species except ?*Ectypodus silberlingi* (diagnosed below) and *Parectypodus tardus* (from which it differs in the presence of  $P_3$ ). Length  $P_4$ , 16 specimens, 2.5–3.7 mm, mean 3.1 mm, type 3.3 mm. Length  $M_1$ , 8 specimens, 1.7–2 mm, mean 1.9 mm, type 1.7 mm. Length  $M_2$ , 5 specimens, 0.9–1.1 mm, mean 1 mm, type 0.9 mm. Ratio length  $P_4$ : length  $M_1$ , 8 specimens, 1.3–2, mean 1.6, type 1.9. Ser-

<sup>2</sup> It was, in any event, a homonym of *Ptilodus gracilis* (Cope) Osborn, 1893, and was replaced by *Ptilodus admirabilis* Hay, 1930, which is also added to the synonymy of *P. montanus*.

<sup>3</sup> Named for the late Earl Douglass, discoverer of the Crazy Mountain Field.

<sup>4</sup> Named for the late Dr. J. W. Gidley, of the U. S. National Museum.

<sup>5</sup> Named for the late Prof. W. J. Sinclair for his work on the Puerco, Torrejon, and Clark Fork.

rations  $P_4$ , 16 specimens, 10-13, mode 12, type 11. Cusps  $M_1$ , 7 specimens, 6-7:4, mode 7:4, type 6:4.

Genus **ECTYPODUS** Matthew and Granger

**?ECTYPODUS GRANGERI**,<sup>6</sup> new species

*Type*.—U.S.N.M. no. 9801, left lower jaw with  $P_4$ - $M_1$ . Collected by A. C. Silberling..

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Structurally similar to *Ectypodus musculus* but significantly larger. Length : width ratio  $M_1$  larger and cusps  $M_1$  more numerous than in any species referred to *Ptilodus*.  $P_3$  present. Length  $P_4$  (mean of 4 specimens) 5.3. Length  $M_1$  (mean of 3 specimens) 3.4. Ratio length  $P_4$  : length  $M_1$  (type) 1.56. Ratio length  $M_1$  : width  $M_1$  (mean of 3 specimens) 2.4. Serrations  $P_4$ , 4 specimens, 13-14, mode and type 14. Cusps  $M_1$ , 3 specimens, 8:6-7, mode and type 8:7. Apex of  $P_4$  nearly on a level with grinding surface of  $M_1$ .

**?ECTYPODUS RUSSELLI**,<sup>7</sup> new species

*Type*.—U.S.N.M. no. 9765, left lower jaw with  $P_4$ - $M_2$ . Collected by A. C. Silberling..

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Similar to *?E. grangeri* but slightly smaller, external cusps of  $M_1$  more numerous, and  $P_4$  more elevated above  $M_1$ .  $P_3$  present. Also similar to *E. cochranensis*, but notch in anterior base of  $P_4$  much more pronounced. Length  $P_4$  (mean of 3 specimens) 5 mm. Length  $M_1$  (2 specimens) 2.9 mm. Ratio length  $P_4$  : length  $M_1$  (2 specimens) 1.7. Ratio length  $M_1$  : width  $M_1$  (type) 2.4. Serrations  $P_4$  (3 specimens) 13-15, type 14. Cusps  $M_1$  (2 specimens) 10-11:6, type 10:6.

**?ECTYPODUS SILBERLINGI**,<sup>8</sup> new species

*Type*.—U.S.N.M. no. 9798, left lower jaw with incisor and  $P_4$ - $M_2$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—(Type specimen unique.) Similar to *E. musculus* but smaller and more cusps on  $M_1$ . Size close to *?Ptilodus sinclairi*, but  $M_1$  significantly longer absolutely and relative to its width and with more cusps. Length  $P_4$  3.3 mm. Length  $M_1$  2.3 mm. Ratio length  $P_4$  : length  $M_1$  1.4. Length  $M_1$  : width  $M_1$  2.6. Serrations  $P_4$  12. Cusps  $M_1$  9:5 (or perhaps, counting rudiments, 10:6). Crest of  $P_4$  relatively low.

<sup>6</sup> Named for Dr. Walter Granger for his work on the Paleocene of North America and Asia.

<sup>7</sup> Named for Dr. L. S. Russell for his work on the Paskapoo.

<sup>8</sup> Named for A. C. Silberling, who collected most of the mammals herein described.

## Genus PARECTYPODUS Jepsen

?PARECTYPODUS JEPSENI,<sup>9</sup> new species

*Type*.—U.S.N.M. no. 9769, left lower jaw with  $P_4$ - $M_1$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—(Type specimen unique.)  $P_3$  absent and no notch in base of  $P_4$ . Distantly suggestive of *Parectypodus simpsoni*, but very distinct, with fewer serrations on  $P_4$ , absolutely and relatively longer  $M_1$ , and markedly different cusp formula of  $M_1$ . Length  $P_4$  4.3 mm. Length  $M_1$  3.1 mm. Ratio length  $P_4$ :length  $M_1$  1.4. Ratio length  $M_1$ :width  $M_1$  2.2. Serrations  $P_4$  11. Cusps  $M_1$  7:6.  $P_4$  long and low.

## Order INSECTIVORA

## Family ?DELTATHERIDIIDAE

## Subfamily DIDELPHODONTINAE

GELASTOPS,<sup>10</sup> new genus

*Type*.—*Gelastops parvus*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Resembling *Didelphodus* in the known parts but canine more erect, premolars more crowded, trigonid of  $M_1$  longer relative to talonid, trigonids of  $M_{2,3}$  shorter and more elevated,  $M_2$  and particularly  $M_3$  smaller relative to  $M_1$ .  $M^2$  (referred) extremely short and wide, paracone and metacone slightly more external than in *Didelphodus*, metaconule vestigial, no trace of hypocone.

GELASTOPS PARVUS,<sup>11</sup> new species

*Type*.—U.S.N.M. no. 6148, right lower jaw with canine,  $M_1$ ,  $M_3$ , and alveoli. Collected by A. C. Silberling.

*Horizon and locality*.—Referred specimens from Gidley Quarry, type probably from same level, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus as defined above.  $M_1$  (type) length 3.5 mm, width 2.3 mm.  $M_2$  (referred specimen) length 2.5 mm, width 2 mm.  $M_3$  (type and one referred specimen) length 2.7–2.9 mm, width 1.8–1.9 mm.  $M^2$  (referred specimen) length 2.7 mm, width 5 mm.

<sup>9</sup> Named for Dr. G. L. Jepsen for his work on the Paleocene of Wyoming.

<sup>10</sup> Γελαστός, peculiar+δψ, aspect.

<sup>11</sup> *Parvus*, thrifty, small. From its scanty remains and its small size. Gidley noted this as new but left no designation or diagnosis.

## Family LEPTICTIDAE

## Genus PRODIACODON Matthew and Granger

PRODIACODON CONCORDIARCENSIS,<sup>12</sup> new species

*Type*.—U.S.N.M. no. 9637, left lower jaw with P<sub>2</sub>, P<sub>4</sub>, M<sub>3</sub>, and alveoli. Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Much smaller than *Prodiacodon puercensis*. P<sub>4</sub> with paraconid projecting more anteriorly and median, talonid with 3 cusps (4 in *P. puercensis*). M<sub>3</sub> with trigonid slenderer, paraconid more median, talonid less elongate, and 3 (not 4) talonid cusps. P<sub>4</sub> length 2 mm, width 1.1 mm. M<sub>3</sub> length 1.9 mm, width 1.2 mm. (The species may not belong in *Prodiacodon*, but it is evidently closely allied to it, and the specimen is insufficient basis for a generic definition.)

## Genus LEPTACODON Matthew and Granger

LEPTACODON LADAE,<sup>13</sup> new species

*Type*.—U.S.N.M. no. 9640, right lower jaw with P<sub>4</sub>–M<sub>3</sub>. Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Slightly larger than *L. tener* or *L. packi* and slightly smaller than *L. siegfriedti*, structurally closer to the former (subgenus *Leptacodon*) than to the latter (subgenus *Leipsanolestes*). P<sub>4</sub> elongate, paraconid median, metaconid very small but in the same position as in *L. tener*, talonid as in that species. Molar paraconids smaller than in *L. tener* but distinct and internal. Hypoconulids of M<sub>1-3</sub> more projecting than in *L. tener*. Talonid of M<sub>3</sub> more elongate and entoconid smaller. Length M<sub>1-3</sub> in type 4.5 mm.

LEPTACODON MUNUSCULUM,<sup>14</sup> new species

*Type*.—U.S.N.M. no. 9819, left lower jaw with M<sub>1</sub> and M<sub>3</sub>. Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Slightly smaller than *Leptacodon tener*, paraconids more reduced and more strictly internal, talonid of M<sub>3</sub> relatively narrower. M<sub>1</sub> length 1.2 mm. M<sub>3</sub> length 1.1 mm.

<sup>12</sup> *Concordia*, union + arz, fort + -ensis. From the Fort Union Group.

<sup>13</sup> *Ladae*, Latin genitive of *Λάδας*, a Greek (Laconian) athlete famous for his agility and speed, this species presumably having the same qualities.

<sup>14</sup> *Munusculum*, a small gift.

**EMPERODON,<sup>15</sup> new genus**

*Type*.—*Emperodon acmeodontoides*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.— $P_4$  with distinct, subequal paraconid and metaconid, a deep vertical posterior groove between the latter and the posterior crest from the protoconid, the latter crest with a vaguely cusplike swelling (smaller than in *Acmeodon*), external wall of protoconid concave vertically, talonid bicuspid. Molars leptictid, cf. *Prodiacodon*, but paraconids relatively large and internal, cf. *Acmeodon*.

**EMPERODON ACMEODONTOIDES,<sup>16</sup> new species**

*Type*.—U.S.N.M. no. 9850, right lower jaw with  $P_4$ ,  $M_2$ , and part of  $P_3$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus.  $P_4$  (type) length 2.8 mm, width 1.9 mm.  $M_2$  (type and one referred specimen) length 2.9–3 mm, width 2.2–2.3 mm.  $M_3$  (referred specimen) length 2.9 mm, width 1.9 mm.

**Family NYCTITHERIIDAE**

Although very distinct from any other known genus, the following form is more conveniently placed in this family than any other.

**STILPNODON,<sup>17</sup> new genus**

*Type*.—*Stilpnodon simplicidens*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont..

*Diagnosis*.— $P_4$  with very high, slender main cusp, minute rudimentary anterior basal cuspule, no metaconid, simple nonbasined talonid with one cuspule.  $M_3$  reduced, distinct, low, nearly median paraconid, trigonid erect and moderately elevated above talonid, protoconid large, trigonid nearly as long as talonid, talonid short.

**STILPNODON SIMPLICIDENS,<sup>18</sup> new species**

*Type*.—U.S.N.M. no. 9629, left lower jaw with  $P_{3-4}$ ,  $M_3$ , and alveoli.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus.  $P_4$  length 1 mm.  $M_3$  length 1.2 mm.

<sup>15</sup> Ἐμπερῶν, deformed + ὀδούς, tooth. From its peculiar  $P_4$ .

<sup>16</sup> *Acmeodon*(i) + -oides, from its resemblance to *Acmeodon*.

<sup>17</sup> Στιλπνός, glistening + ὀδούς, tooth.

<sup>18</sup> *Simplex*, simple + *dens*, tooth. From the simple  $P_4$ .



## Family PANTOLESTIDAE

The following genus, fairly common in the quarry collections, is evidently allied to *Pentacodon*, but the pertinence of it and *Pentacodon* to the Pantolestidae is not well established. Another form is generically indistinguishable from *Palaeosinopa* and surely belongs in the Pantolestidae, but is not closely related to *Pentacodon* or *Aphronorus*.

APHRONORUS,<sup>10</sup> new genus

*Type*.—*Aphronorus fraudator*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Generally similar to *Pentacodon*.  $P_4$  with anterior end less produced downward than in *Pentacodon*, talonid more distinctly basined, with second cuspule more distinct.  $M_{2-3}$  less reduced relative to  $M_1$ . Trigonid of  $M_{1-2}$  relatively shorter and entoconids relatively higher than in *Pentacodon*. Three talonid cusps of  $M_3$  more distinct.  $P^4$  with metacone well differentiated but smaller than paracone, protoconule distinct.  $M^1$  and to less degree  $M^2$  slender and more transverse than in *Pentacodon*, more leptictid in aspect.

APHRONORUS FRAUDATOR,<sup>10</sup> new species

*Type*.—U.S.N.M. no. 6177, left lower jaw with  $P_4$ – $M_3$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry (one specimen from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of the genus. Much smaller than *Pentacodon inversus*. Lengths of lower teeth, in millimeters:  $P_4$  (10 specimens) 3.2–3.8,  $M_1$  (10 specimens) 2.8–3.1,  $M_2$  (12 specimens) 2.5–2.9,  $M_3$  (7 specimens) 2.6–2.9.

## Genus PALAEOSINOPA Matthew

PALAEOSINOPA DILUCULI,<sup>11</sup> new species

*Type*.—U.S.N.M. no. 9810, left lower jaw with  $P_4$ – $M_2$ . Collected by A. C. Silberling.

*Paratype*.—U.S.N.M. no. 9553, left upper jaw with  $P^4$ – $M^3$  (somewhat broken). Collected by A. C. Silberling.

*Horizon and locality*.—Gidley and Silberling Quarries, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Much smaller than any other known species of *Palaeosinopa*.  $P_4$  strongly trenchant, with large anterior basal cusp and incipient basining of talonid. Molar cusps high and slender.  $M^{1-2}$  with smaller hypocones than in most advanced species. Metacone of  $M^3$  distinct. Length  $M^{1-2}$  6.1 mm.

<sup>10</sup> *Ἀφρων*, crazy + *ὄρος*, mountain. From the locality; also in analogy with the many American fossils named for mountain ranges.

<sup>10</sup> *Fraudator*, deceiver. From its resemblances to various different families (as Arctocyoniidae, Leptictidae, and Hyopsodontidae), resemblances of which the majority must be deceitful.

<sup>11</sup> *Diluculi*, of the dawn. From its great age.

## Family MIXODECTIDAE

The following genus is so distinctive that it may not belong in this family, but it compares more nearly with *Mixodectes*, *Cynodontomys*, and their respective allies than with other genera known to me.

EUDAEMONEMA,<sup>22</sup> new genus

*Type*.—*Eudaemonema cuspidata*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Dental formula  $\overline{2.1.4.3}$ . Median incisor much enlarged. Canine reduced, but larger than lateral incisor or  $P_1$ .  $P_{1-2}$  small, one rooted.  $P_4$  submolariform, comparable with *Cynodontomys*, with distinct paraconid, large, high metaconid, and basined, tricuspid talonid. Molar structure nearly as in *Mixodectes* (or *Indrodon*) but trigonids more elevated and all six cusps sharper and more distinct.

EUDAEMONEMA CUSPIDATA,<sup>23</sup> new species

*Type*.—U.S.N.M. no. 9314, left lower jaw with C,  $P_2$ – $M_3$ , and roots or alveoli of all other teeth. Found by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry (and one specimen from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus as defined above.  $M_{1-3}$  (type) 10.9 mm.

## Order PRIMATES

Dr. Gidley (1923, *op. cit.*) published thorough descriptions of the Fort Union Primates, and this is the only part of his projected memoir that can be considered as definitively completed by him. The rapid advances in knowledge during the past 12 years, nevertheless, necessitate reconsideration of his conclusions. These do not affect taxonomy, the sole concern of this paper, except in requiring the generic separation of one of Gidley's species. Gidley foresaw that this species was probably generically distinct, but with proper conservatism did not give a name that would require fuller validation by later research. The family position of these primate genera is dubious and requires more detailed discussion than can be given here.

PALENOCHTHA,<sup>24</sup> new genus

*Type*.—*Palaechthon minor* Gidley, 1923.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Dental formula probably  $\frac{?.?.?.3.}{1.1.2.3}$ . Anterior lower dentition shorter than in *Paromomys* or *Palaechthon* and apparently

<sup>22</sup> Εὐδαίμωνμα, a piece of good fortune. Analogous with *Olbodotes* ("bearer of bliss").

<sup>23</sup> *Cuspidata*, cuspidate. I borrow the name from a label by Gidley, "*Indrodon* or new genus, *cuspidatus*", on a specimen probably of this species. There is no manuscript by him definitely referring to this form. The specimens referred to this species are highly variable—Gidley's labels suggest that he was inclined to place them in several different genera and species—but they seem not to be clearly separable specifically.

<sup>24</sup> Anagram of *Palaechthon*.

with one more tooth absent, probably  $P_2$ .  $P_4$  of about the same length relative to  $M_1$  as in *Palaeckthon*, but relatively higher, with no trace of the metaconid and only a very vague rudiment of the paraconid.  $M_{1-2}$  similar to *Palaeckthon*, but  $M_3$  with smaller third lobe and undivided hypoconulid. Upper molars comparable with *Paromomys* and *Palaeckthon* but very slender, transverse, and more triangular, posterointernal expansion much weaker, inner base not bilobed, and  $M^3$  shorter relative to  $M^2$ .

## Order CARNIVORA

### Family ARCTOCYONIDAE

Gidley (1919, *op. cit.*) placed most of the Fort Union and some of the Torrejon arctocyonines in a new genus, *Neoclaenodon*. Thorough restudy with greatly augmented materials shows that the separation from *Claenodon* is not valid. It was based essentially on one specimen of each supposed genus, and analysis of many specimens shows that a generic distinction does not exist. Among many other points this is emphasized by the fact that Gidley defines *Neoclaenodon* as having the premolars more reduced than in *Claenodon*, and Matthew (ms.) says they are less reduced in *Neoclaenodon*.

There is a new species of this group, collected since Dr. Gidley's death, and a new genus based on a new species recognized but not published by him.

#### Genus CLAEONODON Scott

##### CLAEONODON VECORDENSIS,<sup>24</sup> new species

*Type*.—U.S.N.M. no. 13781, left  $M^{2-3}$ . Collected by A. C. Silberling and G. G. Simpson, 1932.

*Horizon and locality*.—Locality 9, 300 feet above base of the recognized Fort Union, Crazy Mountain Field, Mont. (This is about 900 feet below the Gidley Quarry, but probably still in the Middle Paleocene.)

*Diagnosis*.— $M^2$  similar to that of *C. silberlingi* in outline but 10 to 20 percent larger, somewhat more transverse, hypocone vestigial, and strong, crenulated internal cingulum.  $M^3$  relatively as large as in *C. ferox* and similar, but metacone smaller, external border more evenly rounded, and hypocone present although rudimentary.  $M^2$  length 9 mm, width 13.5 mm.  $M^3$  length 6.7 mm, width 10 mm.

##### DEUTEROGONODON,<sup>25</sup> new genus

*Type*.—*Deuteronodon montanus* Gidley, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

<sup>24</sup> *Vecors*, crazy+*-ensis*, geographical adjectival suffix.

<sup>25</sup> *Δεύτερος*, second, subsequent + *γωνία*, angle + *-δούς*, tooth. Named in analogy with *Protogonodon*.

*Diagnosis.*—Dentition basically arctocyonid and resembling *Protogonodon* and *Claenodon*. Distinct, small hypocone on  $M^{2-3}$  (at least), cingula almost completely circling these teeth. Small but well-defined mesostyle present. Parastyle of  $M^3$  a distinct, strongly projecting cusp. Lower molars with trigonid only slightly higher than talonid, metaconid smaller than but as high as protoconid. Paraconid very small, subconical, on anterior slope of metaconid. Talonid basin open with continuous crescentic lophid differentiated into three apices. Enamel wrinkled, but little or no tendency to form accessory cusps.

**DEUTEROGONODON MONTANUS** Gidley, new species, ex ms.<sup>17</sup>

*Type.*—U.S.N.M. no. 6160, part of right maxilla with  $M^3$  complete and broken  $M^{1-2}$ , and left lower jaw fragment with talonid of  $M_1$  and most of  $M_2$ . If these should prove not to be of one individual, the upper jaw is to be taken as type and the lower as a paratype. Collected by A. C. Silberling.

*Paratype.*—U.S.N.M. no. 6161, isolated right  $M_2$ .

*Horizon and locality.*—Locality 25, about 400 feet below Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis.*—Gidley: "Somewhat larger than *P. [Protogonodon] pentacus* (Cope)."

Simpson: Sole known species of genus as defined above.  $M^2$  median width 14.6 mm.  $M^3$  length 10 mm.  $M_2$  (paratype) width 10.5 mm, length 12.6 mm.

The following new genus is in several ways transitional between the so-called arctocyonine and oxycloenine creodonts. It helps to emphasize the fact that a separation of more than subfamily rank, at most, is unjustified between these two groups. Among the smaller and more strictly carnivorous forms, the oxycloenines proper, there are two new sharply distinct species of *Chriacus*, two new genera probably allied to *Chriacus*, and a species related to *Tricentes* and tentatively retained in that genus but so distinctive that it may be necessary to create another genus for it when it is better known.

**PROTHRYPTACODON**,<sup>28</sup> new genus

*Type.*—*Prothryptacodon furens*, new species.

*Distribution.*—Middle Paleocene, Fort Union, Mont.

*Diagnosis.*—Canine semiprocumbent, root extending beneath premolars (as in *Thryptacodon*).  $P_{1-2}$  spaced widely.  $P_4$  similar to

<sup>17</sup> Dr. Gidley's notes contain two drafts of a description of this species, in both of which it is referred to *Protogonodon*. On one the words "new genus" have later been written under "*Protogonodon*," but there is no generic name or diagnosis. Dr. Gidley thus recognized both genus and species as new, but only the latter can be published as by him.

<sup>28</sup> Πρ6, before + *Thryptacodon*.

*Thryptacodon*. Molar trigonids higher than in *Thryptacodon*, paraconids reduced and in nearly same position as in *Thryptacodon*, but more distinct, higher on crown, trigonids less basined and with fewer accessory cuspules. Only one distinct inner talonid cusp, the entoconid (two in *Thryptacodon*).

**PROTHRYPTACODON FURENS,<sup>29</sup> new species**

*Type*.—U.S.N.M. no. 9260, right lower jaw with  $P_4$ – $M_3$  and alveoli. Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry (referred specimen from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus. Measurements of type in millimeters:

$P_4$		$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width	Length	Width
4.9	2.7	5.2	3.7	5.2	4.2	5.3	4.0

**Genus CHRIACUS Cope**

**CHRIACUS PUSILLUS,<sup>30</sup> new species**

*Type*.—U.S.N.M. no. 9270, right lower jaw with  $P_2$ – $M_2$ . Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley and Silberling Quarries, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Much smaller than *C. pelvidens*, lower premolars high and slender. Anterior basal cusp and talonid of  $P_4$  relatively small. Trigonoid of  $M_1$  short.  $M_3$  slightly reduced. Measurements of type in millimeters:

$P_1$		$P_3$		$P_4$		$M_1$		$M_2$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
2.8	1.6	3.5	2.0	4.4	2.6	4.9	3.7	5.0	4.3

<sup>29</sup> *Furens*, raging.

<sup>30</sup> *Pusillus*, puny.

**CHRIACUS PUGNAX,<sup>31</sup> new species**

*Type*.—U.S.N.M. no. 13782, right lower jaw with  $M_{1-2}$  and alveoli. Collected by A. C. Silberling and G. G. Simpson, 1932.

*Horizon and locality*.—Locality 78, Fort Union, probably Middle Paleocene (older than Gidley Quarry), Crazy Mountain Field, Mont.

*Diagnosis*.—Much larger than *C. pusillus*, about the size of *C. pelvidens*, but molars markedly wider, trigonids less elevated, talonid of  $M_1$  notably wider than trigonid.  $M_1$  length 7 mm, width trigonid 4.9 mm, width talonid 5.9 mm.

**METACHRIACUS,<sup>32</sup> new genus**

*Type*.—*Metachriacus punitor*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Premolars like *Chriacus*. Molar trigonids less elevated, paraconids reduced but near metaconids, trigonid basin with crenulated anterior margin, accessory cuspules also tending to develop elsewhere, especially on notched metaconid-entoconid crest. Molars wide and heavy, especially  $M_2$ .

**METACHRIACUS PUNITOR,<sup>33</sup> new species**

*Type*.—U.S.N.M. no. 9288, left lower jaw with  $M_{1-3}$ . Collected by A. C. Silberling.

*Paratype*.—U.S.N.M. no. 9286, right lower jaw with  $P_3$ – $M_3$  ( $M_1$  and  $M_3$  broken). Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Heel of  $P_4$  squarely truncated, inner side nearly basined, with two cuspules. Molars relatively weak, crenulation moderate. Measurements of type in millimeters:

$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width
4.7	3.9	4.9	4.4	6.0	3.8

**METACHRIACUS PROVOCATOR,<sup>34</sup> new species**

*Type*.—U.S.N.M. no. 9278, left lower jaw with  $P_4$ – $M_3$ . Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Locality 51 (probably referable specimen from locality no. 24, near same level, both below Gidley Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Heel of  $P_4$  more pointed, only one distinct cusp. Molars very broad and heavy, crenulations pronounced. Measurements of type in millimeters:

<sup>31</sup> *Pugnax*, combative.

<sup>33</sup> *Punitor*, avenger.

<sup>32</sup> *Mera*, prefix of change of condition, etc. + *Chriacus*.

<sup>34</sup> *Provocator*, one who challenges to combat.

P <sub>4</sub>		M <sub>1</sub>		M <sub>2</sub>		M <sub>3</sub>	
Length	Width	Length	Width	Length	Width	Length	Width
5.0	2.9	5.5	4.1	5.7	5.2	ca. 6.5	4.0

**SPANOXYODON,<sup>35</sup> new genus**

*Type*.—*Spanoxyodon latrunculus*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Symphysis long, subcylindrical, with procumbent canine. P<sub>1-2</sub> absent. P<sub>3</sub>-M<sub>2</sub> closely similar to *Chriacus* but metaconid of P<sub>4</sub> larger and paraconid of M<sub>2</sub> more median than in the genotype and probably other species of *Chriacus*.

**SPANOXYODON LATRUNCULUS,<sup>36</sup> new species**

*Type*.—U.S.N.M. no. 9287, left lower jaw with canine alveolus and P<sub>3</sub>-M<sub>2</sub>. Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus. Measurements of type in millimeters:

P <sub>3</sub>		P <sub>4</sub>		M <sub>1</sub>		M <sub>2</sub>	
Length	Width	Length	Width	Length	Width	Length	Width
3.8	2.3	5.0	2.8	5.2	3.9	5.8	4.5

**Genus TRICENTES Cope**

**TRICENTES LATIDENS<sup>37</sup> Gidley, new species, ex. ms.**

*Type*.—U.S.N.M. no. 9269, left lower jaw with canine and P<sub>2</sub>-M<sub>3</sub>. Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

<sup>35</sup> *Traxos*, few + *stos*, pointed + *stos*, tooth. From the reduced premolars.

<sup>36</sup> *Latrunculus*, a small bandit.

<sup>37</sup> *Latus*, wide + *dens*, tooth, in allusion to the wide talonids. Dr. Gidley's notes are sketchy and were clearly only preliminary, but they plainly distinguish the species and apply a name to it. I designate as type a specimen surely conspecific with that suggested in the notes and much better preserved. It seems almost certain that this change was intended by Gidley, although not clearly made in his notes.

*Diagnosis*.—Gidley: "About the equivalent of *T. subtrigonus* in size but presents the following differences: (1) The teeth are more massive, (2) the molars are relatively wider especially in the region of the heel \* \* \* (4) \* \* \* the paraconid is \* \* \* more closely appressed to the metaconid \* \* \*".

Simpson:  $P_{3-4}$  markedly heavier than in *T. subtrigonus*.  $M_{1-2}$  similar but paraconid more internal and nearly confluent with metaconid.  $M_3$  relatively shorter and wider. Measurements of type in millimeters:

$P_2$		$P_3$		$P_4$		$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
3.6	2.8	4.6	3.3	5.4	4.0	5.5	4.7	6.0	5.5	6.1	4.7

### Family MIACIDAE

There are at least four very distinct species of miacids in the collection. One is poorly known and near *Didymictis haydenianus*, from which it cannot properly be distinguished. Of the others, one certainly represents a new genus and the other two may be referred to *Didymictis*, although sharply distinct from other species of that broadly drawn genus.

#### ICTIDOPAPPUS,<sup>35</sup> new genus

*Type*.—*Ictidopappus mustelinus*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Differing from *Didymictis* in the relatively smaller and much simpler  $P_{3-4}$  and relatively lower and longer trigonid of  $M_1$ , from *Viverravus* in the wider and more triangular  $P_4$  and more definitely basined talonids, and from other miacids in the absence of  $M_3$ .  $P_4$  shorter than  $M_1$  but nearly as high, relatively wide, subtriangular, not markedly trenchant, paraconid and metaconid barely indicated, talonid very short, vaguely cusped, no other cuspules and no cingulum.

#### ICTIDOPAPPUS MUSTELINUS,<sup>36</sup> new species

*Type*.—U.S.N.M. no. 9296, right lower jaw with  $P_3$ – $M_1$  and talonid of  $M_2$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of the genus as defined above. Measurements of type in millimeters as follows:

<sup>35</sup> *ἰκτίς*, weasel + *πάππος*, grandfather. Also in analogy with *Viverravus*.

<sup>36</sup> *Mustelinus*, relating to or resembling a weasel.



P <sub>3</sub>		P <sub>3</sub>		M <sub>1</sub>	
Length	Width	Length	Width	Length	Width
2.0	1.4	2.9	1.9	3.8	2.3

### Genus DIDYMICTIS Cope

#### DIDYMICTIS TENUIS,<sup>40</sup> new species

*Type*.—U.S.N.M. no. 9297, part of left lower jaw with broken P<sub>4</sub> and complete M<sub>1</sub>. Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Much smaller than any comparable miacid. P<sub>4</sub> with short high main cusp and single posterior cusp, both subconical, M<sub>1</sub> with very elevated trigonid, hypoconid and entoconid about equally high and distinct. M<sub>1</sub> length 2.9 mm, width 1.8 mm.

#### DIDYMICTIS MICROLESTES,<sup>41</sup> new species

*Type*.—U.S.N.M. no. 9301, left lower jaw with P<sub>4</sub>–M<sub>2</sub>. Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry (and one referred specimen from Silberling Quarry), Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Generally similar to *D. haydenianus* but much smaller, anterior cusp of P<sub>4</sub> higher and more trenchant, heel of P<sub>4</sub> with one central cuspule and one very small marginal posterior cuspule, posterior end of P<sub>4</sub> relatively wider and more transverse, talonid of M<sub>2</sub> almost as wide as trigonid. Measurements of type in millimeters as follows:

P <sub>4</sub>		M <sub>1</sub>		M <sub>2</sub>	
Length	Width	Length	Width	Length	Width
4.2	2.1	4.3	3.2	3.3	2.2

## Order CONDYLARTHRA

### Family PHENACODONTIDAE

Most of Dr. Gidley's manuscript notes refer to this group, and he evidently planned a preliminary paper on it. There are three separate

<sup>40</sup> *Tenuis*, feeble. Gidley notes that two or three new species of this genus or family are present, but his records contain no exact reference to these species.

<sup>41</sup> *Micros*, small-plunderer.

drafts of part of his brief account of the phenacodonts. None is complete, it is not certain which is most recent, they are not consistent with each other, and they have notations for further study never made or, at least, recorded. It is thus improper to publish these notes as they stand and impossible to edit them in such a way as to be sure of representing Dr. Gidley's views correctly. I have therefore studied the group *de novo*, but have incorporated as many of Gidley's names and diagnoses as possible.

### Genus TETRACLAENODON Scott

TETRACLAENODON SYMBOLICUS Gidley, new species, ex ms.

*Type*.—U.S.N.M. no. 6169, part of right lower jaw with  $M_1$  and alveoli of  $P_{3-4}$  and  $M_2$ . Collected by A. C. Silberling.

*Paratype*.—(Added by Simpson.) U.S.N.M. no. 6168, jaw fragment with right  $M_{1-2}$  and an isolated left  $P_4$ . Collected by A. C. Silberling.

*Diagnosis*.—Gidley: "This species is smaller than *E. [Tetraclaenodon] puercensis*, being about intermediate in size between that species and *E. minor [Tetraclaenodon pliciferus]*. The lower molars are proportionately narrower transversely than those of the former species and the lower jaw is much shallower. This last character may be due in part, however, to a less mature condition of the specimen which represents a young individual with the first true molar just coming into use. The striking similarity in detail of the lower molars with those of *E. [T.] puercensis* is a notable feature of the species and separates it clearly from *E. minor [T. pliciferus]*. The more notable points of similarity are the slight roughening and wrinkling of the enamel surface and a tendency of the teeth to break up into small cuspules."<sup>42</sup>

Simpson: Intermediate between *Tetraclaenodon pliciferus* and *T. puercensis* in size but nearer the former both in size and structure. The only constant difference from *T. pliciferus* is greater size, inadequate for specific differentiation were it not correlated with wide geographic separation. Crenulations perhaps slightly more pronounced and paraconid weaker than in *T. pliciferus*, but these are highly variable characters of doubtful taxonomic value.  $M_1$ , 3 specimens, length 7.5–7.9 mm, width 6.3–6.4 mm.  $M_2$ , 2 specimens, length 7.8–8.2 mm, width 7 mm. Ratio trigonid width : talonid width  $M_2$  1.01–1.06.

### ?TETRACLAENODON SUPERIOR,<sup>43</sup> new species

*Type*.—U.S.N.M. no. 11913, part of left lower jaw with talonid of  $M_1$ , unworn  $M_2$ , and  $M_3$  in capsule. Collected by A. C. Silberling.

*Horizon and locality*.—Locality 11 or 13, about 3,000 feet above the Gidley Quarry, Fort Union, Middle or perhaps Upper Paleocene horizon, Crazy Mountain Field, Mont.

<sup>42</sup> This appears to be a good distinction from figures of *T. pliciferus*, but actual specimens of the latter do not differ markedly from *T. symbolicus* in this respect.—G. G. S.

<sup>43</sup> Superior, higher, in reference to its stratigraphic position.

*Diagnosis*.—Molars about as long as in *T. symbolicus*, but markedly narrower. Crenulation slight. Paraconid vestigial, trigonid broadly basined with crenulated anterior margin. External cingulum absent.  $M_2$  length 7.7 mm, width 6.2 mm. Ratio trigonid width: talonid width  $M_2$  1.13. This species may belong to *Gidleyina* (infra).

#### GIDLEYINA, new genus <sup>44</sup>

*Type*.—*G. montanensis* Gidley, new species.

*Distribution*.—Paleocene, Fort Union, Mont.

*Diagnosis*.—Closely resembling *Ectocion*, but upper premolars with much smaller metacones, first and second molars with smaller mesostyles and hypocones, protoconules of  $P^3$ - $4$  and  $M^1$ - $2$  slightly more united by lophs to protocone. Among Middle Paleocene genera closest to *Protoselene*, but sharply distinguished by large postero-internal protocone on  $P^3$ , distinct conules on  $P^4$ , and other details.

#### GIDLEYINA MONTANENSIS Gidley, new species, ex ms.

*Type*.—Princeton no. 12048, part of left maxilla with  $P^3$ - $M^2$  and a probably associated right  $P^2$ .

*Horizon and locality*.—Locality 68, about 1,000 feet above Gidley Quarry, Fort Union, Crazy Mountain Field, Mont.

*Diagnosis*.—Gidley: <sup>45</sup> "Parastyle and mesostyle prominent, mesostyle angular and continuous with the ectoloph;  $P^4$  with internal cingulum and with low but well-defined lophs connecting the summit of the protocone with the protoconule and base of the metacone, respectively."

Simpson: Measurements in millimeters as follows:

$P^2$		$P^3$		$P^4$		$M^1$		$M^2$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
4.5	3.1	5.9	5.8	5.7	7.2	7.0	9.0	6.9	9.9

#### ?GIDLEYINA SILBERLINGI Gidley, new species, ex ms.<sup>46</sup>

*Type*.—U.S.N.M. no. 6166, partial left lower jaw with  $P_3$ - $M_3$ . [Three other fragments are included in the same lot and probably are

<sup>44</sup> In one draft of Gidley's notes the genotype is referred to *Euprotogonia*, in another to *Ectocion*, and in another to a new genus. Even supposing the last to be his latest opinion, as it probably was, I cannot validate Gidley's authorship of the genus as the name he uses is preoccupied. It is appropriate that a genus that he recognized and one of the most important in the collection that he worked on for so long should be named for Dr. Gidley. (*Gidleya* Cossman, 1907, is a fossil bovid.)

<sup>45</sup> Much of the diagnosis consists of measurements, which I replace with new figures.

<sup>46</sup> This species was at first referred to *Euprotogonia* and then to *Ectocion* by Gidley. Probably he finally recognized its probable pertinence to the genus I have called *Gidleyina*, but this does not appear in his notes. Only enough of his diagnosis is quoted to validate his authorship of the species; it is based on reference to *Euprotogonia* [*Tetracaelonodon*] and is therefore not fully apropos.

conspecific, but more than one individual is present, and I exclude all but the principal specimen from the type material.—G. G. S.] Collected by A. C. Silberling.

*Horizon and locality*.—Locality 27, about 500 feet above the Gidley Quarry, Fort Union, Crazy Mountain Field, Mont.

*Diagnosis*.—Gidley: “\* \* \* Jaw relatively long and slender, especially anteriorly; the teeth proportionately narrow transversely \* \* \* with a decided tendency to selenodonty \* \* \*. The paraconid in the molars is vestigial or lacking, and  $P_4$  is submolariform \* \* \* the heel \* \* \* having the crescentic form of that of the molars, while the metaconid is large and as high as the protoconid.”

Simpson: Not directly comparable with *Gidleyina montanensis*.<sup>47</sup> Generically distinct from any other described lower jaws. Differing from all species of *Ectocion* in the crescentic talonid crest of  $P_3$ , less molariform  $P_4$ , and some details in the molars, from *Tetraclaenodon* in the talonid basin and crescent of  $P_3$ , somewhat less distinct molar paraconids, smoother enamel and fewer crenulations, and from *Protoselene* in the much more molariform  $P_{3-4}$ . Measurements in millimeters as follows:

$P_3$		$P_4$		$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
6.7	3.9	7.2	4.7	7.0	5.4	7.3	5.4	7.3	4.6

### Family HYOPSODONTIDAE

Hyopsodontids are very abundant in the quarry collections. The most typical and common Torrejon genus, *Mioclaenus*, has not been identified in the collection, but there is a distinctive species tentatively referable to the Torrejon genus *Ellipsodon*, and there are three new genera. All these, even including the species placed in *Ellipsodon*, show a more marked resemblance to the later hyopsodontids, or to the hyopsodontines as opposed to the mioclaenines, than do the Torrejon forms. They thus tend in a very important way to corroborate Matthew's union of the frequently separated supposed families Mioclaenidae and Hyopsodontidae, and they make even a subfamily distinction between the two groups impractical on present data.

<sup>47</sup> This may be the lower dentition of *G. montanensis*, but this cannot be demonstrated, and there is some indirect evidence against it, making even generic identity uncertain. In view of these doubts it seems practical and warranted to follow Gidley and list this important form as a species.

Genus **ELLIPSODON** Scott**ELLIPSODON AQUILONIUS**,<sup>48</sup> new species

*Type*.—U.S.N.M. no. 9280, right lower jaw with  $P_3$ – $M_3$  and alveoli. Collected by A. C. Silberling.

*Paratype*.—U.S.N.M. no. 9567, right upper jaw with  $P^3$ – $M^2$ . Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley and Silberling Quarries, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Closest to *Ellipsodon acolytus* among previously named species. Teeth in general somewhat slenderer in build. Metaconid of  $P_4$  more distinct. Talonid of  $M_3$  more elongate and narrow. Resembles *Litaletes* in the advancing molarization of  $P_4$ , but generally nearer to *Ellipsodon*. Measurements of type in millimeters:

$P_3$		$P_4$		$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
3.3	1.9	3.5	2.4	3.1	2.7	3.2	3.0	3.7	2.6

**LITALETES**,<sup>49</sup> new genus

*Type*.—*Litaletes disjunctus*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Resembles the most primitive species of *Hyopsodus* (e. g., *H. simplex*) in the molarization of  $P^4_4$  and presence of a small, distinct hypocone separate from the protocone. Differs in the relatively larger  $M^3_3$ , rudimentary protocone of  $P^3_3$ , smaller hypocones than any typical *Hyopsodus*, protoconid-metaconid crest less oblique, and paraconid generally less reduced.

**LITALETES DISJUNCTUS**,<sup>50</sup> new species

*Type*.—U.S.N.M. no. 9323, right lower with C– $M_3$  ( $M_3$  broken). Collected by A. C. Silberling.

*Paratype*.—U.S.N.M. no. 9324, right upper jaw with  $P^3$ – $M^3$ . Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus. Measurements of type in millimeters:

<sup>48</sup> *Aquilonius*, northern. Dr. Gidley recognized this species, and there is a rough draft of a diagnosis probably of this form, but the diagnosis and designation of type are ambiguous, and as there is no name in his notes or labels he cannot be quoted as author.

<sup>49</sup> *Atrōs*, simple + *ἀλάρης*, grinder. From the simple molars and in analogy with *Haplomytus*, *Litomylus*, and other genera.

<sup>50</sup> *Disjunctus*, disconnected. From its deviation from other members of the family.

P <sub>1</sub>		P <sub>2</sub>		P <sub>3</sub>		P <sub>4</sub>		M <sub>1</sub>		M <sub>2</sub>		M <sub>3</sub>
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Width
2.2	1.3	2.9	1.7	3.3	1.9	3.5	2.6	3.9	3.4	4.3	3.9	3.4

**LITOMYLUS,<sup>51</sup> new genus**

*Type*.—*Litomylus dissentaneus*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—Lower teeth generally similar to *Protoselene* but relatively narrower and more lightly built. P<sub>4</sub> with sharp anterior blade, rudimentary anterior cuspule low on the crown, low well-defined metaconid separated from protoconid by a distinct pocket, talonid relatively shorter and lower than in *Protoselene*. Talonid of M<sub>3</sub> less elongate. Molar paraconids vestigial and median as in *Protoselene*; unlike *Ellipsodon* or *Litaletes*.

**LITOMYLUS DISSENTANEUS,<sup>51</sup> new species**

*Type*.—U.S.N.M. no. 9425, left lower jaw with P<sub>2</sub>–M<sub>3</sub>. Collected by A. C. Silberling.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus. Measurements of type in millimeters:

P <sub>3</sub>		P <sub>4</sub>		M <sub>1</sub>		M <sub>2</sub>		M <sub>3</sub>	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
3.3	1.7	3.5	1.9	2.9	2.4	3.0	2.7	3.2	2.2

**HAPLALETES,<sup>53</sup> new genus**

*Type*.—*Haplaletes disceptatrix*, new species.

*Distribution*.—Middle Paleocene, Fort Union, Mont.

*Diagnosis*.—P<sub>3</sub> with small basal paraconid and rudimentary metaconid. (P<sub>4</sub> unknown.) Protocone distinct on P<sub>3</sub> and large on P<sub>4</sub>. Rudimentary metacone on paracone slope of P<sub>4</sub>. M<sub>1-2</sub> and particu-

<sup>51</sup> Λίτρος, simple + μίλος, millstone. From the simple molars and in analogy with *Haplomytus*, *Litaletes*, and others.

<sup>52</sup> *Dissentaneus*, disagreeing. From its disagreement with the more common mioclaenines.

<sup>53</sup> Ἀπλάδος, simple + ἀλέτης, grinder. From the single molars and in analogy with *Haplomytus*, *Litaletes*, and others.

larly  $M_3$  short and broad, with very slightly elevated trigonids and low blunt cusps, paraconids vestigial, median, not fusing with metaconids, external cusps lower than internal.  $M^{1-3}$  similar to *Litaletes*, but protocones relatively smaller and hypocones relatively larger.

**HAPLALETES DISCEPTATRIX**,<sup>44</sup> new species

*Type*.—U.S.N.M. no. 9500, right lower jaw with  $P_3$ – $M_3$ . Collected by A. C. Silberling.

*Paratype*.—U.S.N.M. no. 9555, right upper jaw with  $P^2$ – $M^3$ . Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Sole known species of genus. Dimensions of type in millimeters:

$P_3$		$P_4$		$M_1$		$M_2$		$M_3$	
Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
2.1	1.4	2.5	1.6	2.4	2.2	2.6	2.6	2.8	2.2

## Order AMBLYPODA

The only peripitychid so far found is an anisonchine apparently indistinguishable from the Torrejon *Anisonchus sectorius*. The absence of *Peripitychus*, so abundant in contemporaneous beds elsewhere, is striking and emphasizes the poor representation of the macrofauna in contrast with the remarkable variety of the microfauna.

### Family PANTOLAMBDIDAE

#### Genus PANTOLAMBDA Cope

##### PANTOLAMBDA INTERMEDIUS, new species

*Type*.—U.S.N.M. no. 8384, left lower jaw with  $M_{1-3}$  and alveoli of C– $P_4$ , associated with symphysis fragment with right  $I_{1-2}$  and alveoli of left  $I_{1-3}$ . Collected by Dr. J. W. Gidley.

*Horizon and locality*.—Gidley Quarry, Fort Union, Middle Paleocene horizon, Crazy Mountain Field, Mont.

*Diagnosis*.—Intermediate in size between *P. bathmodon* and *P. caviroctus*.  $P_1$  with one large root, close to canine, followed by short diastema.  $P_{2-4}$  2-rooted. Lower molars closely resembling those of *P. caviroctus* but entoconid more distinct.  $M_1$  length 13.2 mm, width 11.2 mm.  $M_2$  length 14.8 mm, width 12.1 mm. (The widths may have been reduced somewhat by corrosion.)

<sup>44</sup> *Disceptatrix*, one who decides. From its apparently decisive evidence of union between the hypsodonts and mioclaenines.



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FIVE NEW GENERA AND TWO NEW SPECIES OF  
UNSTALKED CRINOIDS

By AUSTIN H. CLARK

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IN revising the genera and species of the large comatulid family Antedonidae, it was found that a more precise definition of certain generic groups was desirable. This is made possible by the creation of three additional genera the recognition of which will assist in bringing out more clearly the true interrelationships of the species in the groups concerned. In addition to these three genera there are described herein a new genus based upon a hitherto undescribed species from the northeastern Pacific and a genus that has long been used by the author but never formally diagnosed.

A small West Indian comatulid recorded from the *Blake* collection by Dr. P. H. Carpenter as *Antedon hagenii* was for a long time a mystery, as none of the specimens were received by Hartlaub when, after Carpenter's death, the *Blake* collection was sent to him. This now turns out to be a species quite different from *Coccometra hagenii*, and it is described below as *Compsometra nuttingi*. It is assigned to the genus *Compsometra* with some misgivings, but until more adequate and more extensive material is available it seems better to place it here than to create a new genus for it.



Genus *COMPSOMETRA* A. H. Clark*COMPSOMETRA NUTTINGI*, new species

*Antedon hagenii* (part) P. H. CARPENTER, Bull. Mus. Comp. Zool., vol. 9, no. 4, pp. 154-156 (pp. 4-6 of separate), 1881 (Dominica to Grenada; 75-291 fathoms; Barbados; Grenada).

*Antedon hageni* (part) P. H. CARPENTER, *Challenger Reports*, Zoology, vol. 26, pt. 60, pp. 22, 54, 207, 367, 368, 373, 377, 1888 (Caribbean Islands).—A. AGASSIZ, Bull. Mus. Comp. Zool., vol. 15 (reprinted as "Three Cruises of the *Blake*"), pt. 2, p. 124, 1888 (Dominica to Grenada; 75-291 fathoms).

*Coccometra hagenii* (part) A. H. CLARK, Univ. Iowa Studies in Nat. Hist., vol. 9, no. 5, pp. 8, 26, 27, 1921.

*Description*.—The centrodorsal is hemispherical, or low and broadly rounded conical, with a broad area free of cirri and covered with relatively large papillae from the center of which the low, rounded, conical, dorsal pole protrudes.

The cirri are XXV-XXX, 9-11, 3.5 to 5 mm long. The first segment is not so long as broad; the second is longer than broad, strongly constricted centrally with the distal end prominent; the third is about four times as long as the median width with the terminal fourth expanded; the fourth is the longest, about five times as long as the median width; the fifth is about as long as the third; and the sixth is about three times as long as the median width. The segments following decrease in length to the second before the last, which is twice as long as the median width, the antepenultimate, which is half again as long as broad, and the terminal, which is slightly longer than broad and bears a blunt opposing spine. The distal ends of the third and following segments are expanded and produced all around into a thin transparent border that overlaps the base of the segments succeeding; this becomes less prominent on the short distal segments.

The 10 arms are 25 to 40 mm in length. The earlier brachials have the central portion of the distal edge strongly produced and armed with several stout webbed spines. Beyond the second syzygy the brachials are constricted centrally and have produced and spinous distal ends. The distal brachials are much elongated and very strongly constricted centrally; the syzygial unions are also much swollen.

The distal intersyzygial interval is usually two muscular articulations.

P<sub>1</sub> is long and slender, evenly and gradually tapering and becoming very delicate distally. It is composed of 18 to 20 segments of which the first is about as long as broad, the second is slightly longer than broad, the third is twice as long as the median width, strongly constricted centrally, and the remainder are much elongated, four or five times as long as the median width, with swollen proximal ends and the distal ends strongly flaring and spinous.

$P_2$  is about two-thirds as long as  $P_1$  and is much stouter basally, though becoming very slender in the distal half. It is composed of 11 to 12 segments of which the first is short, the second is longer than broad, and the third and following are much elongated with expanded and spinous distal ends. There is a long ovate gonad on the third-fourth or third-fifth segments. The following pinnules are similar. The lower and middle pinnules have the distal ends of the segments strongly produced and armed with prominent spines. The distal pinnules are very slender.

*Type*.—From the University of Iowa's Barbados-Antigua Expedition station 15; Barbados. U.S.N.M. no. E. 4289.

*Range*.—West Indian Islands, from Cuba to Grenada; from shallow water to 532 meters.

*Remarks*.—This new species, which heretofore has been confused by the author and others with the very different *Coccometra hagenii*, appears to be most closely related to *Compsometra parviflora* of the East Indies.

#### ANNAMETRA, new genus

*Annametra* A. H. CLARK, U. S. Nat. Mus. Bull. 82, vol. 1, pt. 2, pp. 618, 647, 648, 681, 723, 1921; The Danish *Ingolf*-Exped., vol. 4, no. 5, Crinoidea, p. 41 (range), p. 52 (in key), 1923.

*Diagnosis*.—A genus of Antedoninae in which  $P_3$  is of the same length and character as the succeeding pinnules;  $P_1$  and  $P_2$  have 18 to 32 segments;  $P_1$  is shorter than  $P_2$ , though similar to it; and the cirri are short and stout, strongly recurved distally, resembling the cirri of *Antedon petasus*, with 10 to 16 segments.

*Genotype*.—*Cominia occidentalis* A. H. Clark, 1915.

*Range*.—Cape of Good Hope; southern Japan; 0-47 meters.

*Included species*.—*Annametra occidentalis* (A. H. Clark); *A. minuta* (A. H. Clark).

#### CARYOMETRA, new genus

*Diagnosis*.—A genus of Zenometrinae in which the centrodorsal is elongate conical with its sides not divided into radial areas, bearing beneath each radial three columns of cirrus sockets of which the median ends at about the middle of the centrodorsal; the cirri are long but delicate with rather numerous (30-35) segments of which the longest proximal are two to three times as long as broad and the fifteenth and following are about as broad as long, or broader than long, with small terminal dorsal spines; the elements of the IBr series and the lower brachials are not in lateral contact, and their edges are smooth; and all the pinnules are present.

*Genotype*.—*Adelometra tenuipes* A. H. Clark, 1908.

*Range*.—Off Habana, Cuba; 386 meters.

*Included species*.—*Caryometra tenuipes* (A. H. Clark).

## EOMETRA, new genus

*Diagnosis*.—A genus of Zenometrinae in which the centrodorsal is small, conical with somewhat swollen sides, about as high as broad at the base, almost completely covered with cirrus sockets, which are arranged in 10 closely crowded columns of 2 or 3 each; the cirri are slender and only slightly curved distally, gradually tapering to a fine point, with all the segments except the basal much elongated and without dorsal processes; the elements of the IBr series and lower brachials are smooth and not in lateral contact; all the pinnules are present;  $P_1$  and  $P_2$  are similar, the latter the longer;  $P_3$  and the pinnules following are much longer than  $P_2$ .

*Genotype*.—*Psathyrometra antarctica* A. H. Clark, 1915.

*Range*.—Antarctic; 2,725 meters.

*Included species*.—*Eometra antarctica* (A. H. Clark).

## BOLEOMETRA, new genus

*Diagnosis*.—A genus of Bathymetrinae in which the first six or seven segments of  $P_1$  are as broad as, or broader than, long; there are not more than 30 cirrus segments; and the brachials and pinnule segments have smooth distal edges.

*Genotype*.—*Antedon clio* A. H. Clark, 1907.

*Range*.—Southwestern Japan; 195 meters.

*Included species*.—*Boleometra clio* (A. H. Clark).

## RETIOMETRA, new genus

*Diagnosis*.—A genus of Bathymetrinae in which  $P_1$  is much elongated, about twice as long as  $P_2$ , and composed of 20 to 30 segments;  $P_2$  resembles the succeeding pinnules and bears a large gonad; the brachials have slightly produced and spinous distal ends; the centrodorsal is low hemispherical; and the cirri are short with 11 to 20 segments of which the longest are not more than three times as long as broad and the distal do not bear dorsal spines.

*Genotype*.—*Retiometra alascana*, new species.

*Range*.—Southeastern portion of Bering Sea and the Gulf of Alaska; vicinity of Marion Island (southeast of the Cape of Good Hope); 91–1,270 meters.

*Included species*.—*Retiometra alascana*, new species; *Retiometra exigua* (P. H. Carpenter).

## RETIOMETRA ALASCANA, new species

*Description*.—The centrodorsal is very low with a broad bare dorsal pole about one-third the diameter of the centrodorsal in width; the 45 to 60 cirrus sockets are closely crowded and increase slowly in size from the vicinity of the bare dorsal pole to the periphery.

The cirri are XLV-LX, 11-12, 7 or 8 mm long. The first segment is half again to twice as broad as long; the second is nearly twice as long as broad; the third and fourth are nearly three times as long as the median width, slightly constricted centrally; and those following slowly decrease in length so that the antepenultimate is not quite twice so long as broad, at the same time losing the median constriction so that they appear slightly broader in lateral view. The penultimate segment is half again as long as broad. The opposing spine is small, terminal, and directed obliquely forward; its dorsal profile makes practically a straight line with that of the penultimate segment. The terminal claw is about as long as the penultimate segment, rather stout at the base, evenly tapering, and evenly and strongly curved.

The distal edges of the radials are even with the rim of the centro-dorsal. The  $IBr_1$  are extremely short, about six times as broad as long in the median line, just in contact basally, with the lateral edges so strongly convergent as to make almost a straight line with those of their neighbors. The  $IBr_2$  (axillaries) are triangular, broader than long, the anterior angle, which is not produced, approximately a right angle, the anterior sides only slightly concave, the lateral angles extending far beyond the anterolateral angles of the  $IBr_1$ , yet widely separated from those of the adjacent axillaries, and with a slight well-rounded process in the median portion of the proximal border.

The 10 arms are 55 to 75 mm in length. The first brachials are very short, twice as long exteriorly as interiorly, with the proximal half of the inner edges of those of each arm pair in contact and the distal halves diverging at first in a straight line, which later turns abruptly upward in a slightly rounded right angle. The second brachial is much larger and is irregularly quadrate. The first syzygial pair (formed of the third and fourth brachials) is slightly longer interiorly than exteriorly, and about as broad as the median length. The next five brachials are almost oblong, and about half again as broad as long. The following brachials become almost or quite triangular, about as long as broad, and gradually wedge-shaped and elongate distally. The distal edges of the brachials are slightly produced and finely spinous, giving the profile of the arm a regularly serrate appearance.

Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 2 (rarely 3) muscular articulations.

In the type specimen  $P_1$  is 10 mm long with 20+ segments, slender but not attenuated; the first segment is short, the second is about as long as broad, the fourth and fifth are twice as long as broad, and the distal are about four times as long as broad. The elongated segments have somewhat abruptly produced and overlapping distal ends, which are armed with very fine spines.  $P_2$  is 8 mm in length with 13

segments of which the first is broader than long, the second is about as long as broad, the third is twice as long as broad, and the remainder are much elongated with produced and finely spinous ends.  $P_3$  is similar to  $P_2$ , and the pinnules following are similar. After  $P_5$  the gonads gradually become smaller, disappearing after  $P_{10}$ .

*Type*.—From *Albatross* station 3330; north of Unalaska (lat.  $54^{\circ}00'45''$  N., long.  $166^{\circ}53'50''$  W.); 642 meters; bottom temperature  $3.22^{\circ}$  C.; black sand and mud; August 21, 1890. U.S.N.M. no. E. 1141.

*Range*.—Southeastern Bering Sea and the Gulf of Alaska; 291 (?197)–1,270 meters. This species is usually found associated with the very much larger *Florometra asperrima*.

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## NOTES ON THE BUTTERFLIES OF THE GENUS *ENODIA* AND DESCRIPTION OF A NEW FRITILLARY FROM PERU

By AUSTIN H. CLARK

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THE capture at Virginia Beach and at Princess Anne, in Princess Anne County, Va., on September 23 and 24, 1934, of a series of about 30 specimens of a satyrid butterfly belonging to the genus *Enodia* brought up the question of the proper application of the names that have been proposed for the species of this genus.

In 1781 Johan Christian Fabricius (*Species insectorum*, vol. 2, p. 82, no. 363) described *Papilio portlandia* in the following terms:

*Portlandia* 363. P. N. G. alis dentatis fuscis, posticis supra ocellis quinque coecis, subtus septem pupillatis.

Habitat in America meridionali. *Mus. Dom. Yeats.*

Parvus. Alae anticae fuscae versus apicem fascia flavescente maculis tribus ocellaribus atris. Posticae fuscae maculis quinque atris iride flavescente absque pupilla. Subtus fuscae strigis obscurioribus. Anticae versus apicem fascia lata apice bifida alba et in hac ocelli quatuor atri iride flaua, exterioribus pupilla alba. Posticae fuscae versus apicem alba et oculo vnico ante fasciam, sex pone fasciam atris vltimis duobus connatis iride flaua pupillaque oblonga argentea.

This may be translated:

P. N. G. with brown dentate wings, the posterior above with five blind ocelli, below with seven pupiled ocelli. Habitat in southern America. In the [John Pattison] Yeats collection. A small species. Fore wings brown, toward the

apex with a yellowish band with three black eye-spots. Hind wings brown with five black spots tinged with yellowish and without pupils. Beneath brown with darker stripes. Fore wings toward the apex with a broad white band bifurcated apically in which are four black eye-spots tinged with yellow, the outer with a white pupil. Hind wings with a white band toward the apex, a single eye-spot in front of the band, and behind the band six, the last two twinned, tinged with yellow and with an oblong silver pupil.

Fabricius listed *portlandia* between (*Vanessa*) *itea* from New Zealand (362) and (*V.*) *cardui* (364), indicating that he regarded it as a nymphalid related to these two species. In its general appearance it certainly does resemble a nymphalid more than it does most satyrids. The locality "America meridionalis" given by Fabricius means simply "southern America."

In 1787 Fabricius (Mantissa insectorum, vol. 2, p. 45, no. 439) changed the name *portlandia* to *iortlandia*. This was probably merely a typographical error.

Jacob Hübner did not mention Fabricius' *portlandia*, which he seems to have been unable to identify, possibly having been misled by the position between two species of *Vanessa* in which it was placed by that author.

Sometime between 1806 and 1818 (Sammlung exotischer Schmetterlinge, vol. 1) Hübner described and figured *Papilio* (*Oreas marmorata*) *andromacha*. This appears to differ in no way from Fabricius' *portlandia*, of which it is generally conceded to be a synonym. In 1818 (Verzeichniss bekannter Schmetterlinge, p. 61, no. 537) Hübner listed this species as *Enodia andromacha*.

In 1821 (Index exoticorum lepidopterorum, p. 1) Hübner substituted the specific name *androcardia* for *andromacha*, giving no explanation for the change. He wrote simply "Andromacha Pap. nym. f. *Oreas marmorata*: *Enodia Androcardia*." It is possible that the name was changed because of an earlier *Papilio* (*Parnassius*) *andromacha* of Fabricius (Systema entomologiae, p. 466, no. 102, 1775), which is *Acraea andromacha* of the Australian region.

Thomas Say in 1859 (American entomology, vol. 1, p. 81, pl. 36) published a detailed description and colored figures of a specimen of *Hipparchia andromacha* from Arkansas.

In 1878 Ferdinand Heinrich Herman Strecker (Butterflies and moths of North America, p. 148, no. 299) described a specimen from Texas as

ab. a. ♂—Spots on upper surface of primaries very small and almost obsolete, the transverse lines entirely wanting. In the cells (excepting the discoidal) accompanying the veins are broad furry fuscous lines connected inwardly, open outwardly, leaving sagittate spaces of the brown ground colour in the middle of each cell. Mus. Strecker.

In 1888 W. H. Edwards (The butterflies of North America, ser. 3, pt. v, Debis 1) published a detailed account of the life history of

*Debis portlandia* with colored figures of both surfaces of each sex and of the early stages, and gave a survey of the occurrence, habits, and distribution, which covers all the forms. His figures of adults represent the form found in the mountains of West Virginia.

In 1897 (Ent. News, vol. 8, no. 10, p. 236) Dr. Henry Skinner described *Debis creola* from specimens sent to him by G. R. Pilate, who had captured them at Opelousas, La., on July 3, 1897. He said that this was probably what Dr. Strecker described as aberration a, based on a specimen from Texas, and added that Dr. A. G. Butler had recognized this species and that there were specimens in the British Museum from the Godman and Salvin collection, and that the great development of the male sexual patch seemed to him to be of specific importance. Dr. Skinner compared his new species with *portlandia*.

In 1926 (Ent. News, vol. 37, no. 2, p. 42) Dr. Skinner said he knew of *creola* only from the type and allotype in the collection of the Philadelphia Academy and the perfect figure in Holland's Butterfly Book. He said that typical *portlandia* was well figured by Edwards and that the Academy had some nice specimens from as far north as Miniota, Manitoba. The form occurring at Gainesville, Fla., Mobile and Chickasaw, Ala., and Macon, Ga., he called *andromacha*.

In 1932 (Bull. Brooklyn Ent. Soc., vol. 26, no. 5, pp. 234-255) Dr. A. Glenn Richards, Jr., considered in some detail *Enodia portlandia*, *E. p. andromacha*, and *E. creola*. He examined the male genitalia of all three and found no constant morphological differences. "Any two slides, even of the same form," he said, "will show a number of small differences, but these minute gaps are all bridged over in a series of preparations so that we can account for all differences on a basis of individual variation." He remarked: "The distinctions between the northern and southern races of *portlandia* are slight and intangible, southern specimens being larger and presenting a somewhat different aspect (the value of a separate racial name seems superfluous). *Creola*, however, is separated in the male by the sex scaling and more triangular fore wing, but I can not separate possible females of this species from large females of *andromacha*, and know no one who can distinguish them in this sex." He wrote that he found *creola* and *andromacha* flying together along a shady river trail southeast of Athens, Clarke County, Ga., and from a single "play-group" several times took a series of *andromacha* along with a single specimen of *creola*.

In 1935 I recorded (Proc. Ent. Soc. Washington, vol. 37, no. 5, pp. 115-116) a typical male of *Enodia creola* from the Edward T. Owen collection in the United States National Museum that had been taken in Michigan by David Bruce, of Brockport, N. Y., a female of this form from Palos Park, Ill., dated July 9, 1911, and another female without data. These individuals are smaller than those from



Georgia in the National Museum collected by Dr. Richards and are also smaller than the two figured by Dr. W. J. Holland, which I have been permitted to examine through the courtesy of Dr. Hugo Kahl, of the Carnegie Museum at Pittsburgh, Pa.

On September 1-3, 1935, I found *Enodia creola* fairly common along the western border of the Dismal Swamp (Nansemond escarpment) in Nansemond County, Va., from Suffolk southward, and also farther west. Here it occurs in company with *E. portlandia*, in some places in about equal numbers. East of the Dismal Swamp, and in the wetter woods generally, only *E. portlandia* was found. In life both sexes of *E. creola* are easily distinguishable from the corresponding sexes of *E. portlandia* at some distance. Belligerent males of *E. creola* are extremely quick in their movements, resembling vanessids.

The specimens from Princess Anne and Virginia Beach (pl. 22, figs. 3, 4) agree so closely with *portlandia* as described by Fabricius, and with *andromacha* as figured by Hübner, as to leave no doubt of their identity. Twenty additional specimens in the collection of the United States National Museum (of which 13 are in the Barnes collection) agree with them. These are from the following localities:

MISSISSIPPI: Vicksburg, George Dorner, September 1908 (1).

ALABAMA: Chickasaw, Mobile County, W. C. Dukes, May 21, 1921 (1); June 19, 1921 (4); 20, 1922 (2); 25, 1922 (2); August 1, 1920 (1); 8, 1920 (2); 15, 1920 (1); October 22, 1922 (1).

FLORIDA: Gainesville, May 1922 (2).

SOUTH CAROLINA: Charleston (1).

NEW JERSEY: Palisades, George P. Engelhardt, July 20, 1908 (1).

AMÉRIQUE SEPTENTRIONALE: From the Boisdual collection (1).

The form called *Enodia portlandia andromacha* by Richards is the same as that represented by these specimens.

A quite distinct form is that referred to as ab. a ♂ by Strecker, as *Debis creola* by Skinner, and as *Enodia creola* by Richards (pl. 22, figs. 5, 6). This form is now known to range from northern Illinois, Michigan, and Virginia southward to northern Georgia, southern Louisiana, and Texas. It is still rare in collections.

A third form, occurring in the East from southern New Hampshire southward to the higher altitudes of North Carolina and possibly farther (pl. 22, figs. 1, 2) is lighter, less brightly marked, and usually smaller than true *portlandia*. This is the form referred to as *portlandia* by Skinner and Richards, and by American authors generally. It is locally frequent in the mountains of Virginia, where its quick and active movements and its habit of keeping generally low down in the underbrush distinguish it rather sharply from the less active and commonly high flying true *portlandia* of the coastal region. Since none of the names that have been proposed for species of this genus is applicable to it, it may be known as

*ENODIA PORTLANDIA ANTHEDON*, new subspecies

## PLATE 22, FIGURES 1, 2

*Diagnosis*.—In general similar to *E. p. portlandia* (Fabricius); wings beneath without white; ocelli of fore wings beneath in a straight line; ocelli of hind wings beneath each with a circular white pupil. From *E. creola* (Skinner) it differs in the absence of white beneath; in having the post-medial line on the under side of the fore wing with a single angle, at vein 4; in the somewhat less produced primaries, especially of the male; and in the absence of the broad furry band on the upper surface of the primaries in the male.

*Type*.—U.S.N.M. no. 51137 (William Barnes collection), from Lava, Sullivan County, N. Y., taken in June.

A fourth form, ranging from central Maine and Quebec westward to Manitoba seems to be worthy of recognition. It may be known as

*ENODIA PORTLANDIA BOREALIS*, new subspecies

*Diagnosis*.—Closely resembling *E. p. anthedon*; upper surface darker, with the dark margin of the hind wings broader and more uniform; lower surface darker and more brownish, usually with the ground color less varied and sometimes quite uniform, with only faint indications of a narrow lighter line enclosing the rows of spots on the fore and hind wings; on the hind wings the dark band between the light line enclosing the row of spots and the fine submarginal light line is, beyond the fourth and fifth spots, broader—usually much broader—than the distance between the submarginal line and the edge of the wing.

*Type*.—U.S.N.M. no. 51138 (William Barnes collection), from Hymers, Ontario, July 1-7.

Twenty-two specimens are at hand from the following localities:

MANITOBA: Miniota, June 17, 1923, H. Gibbon (1); July 1, 1922 (1); July 10, 1920 (12). Winnipeg, July 1-7 (1); no date (1).

ONTARIO: Hymers, July 1-7 (2).

QUEBEC: Meach Lake, Ottawa County (1); somewhat intermediate between this and the preceding form.

MAINE: Sebec Lake, July 16-23 (1); July 24-31 (2); more or less intermediate between this and the form preceding.

*Enodia portlandia borealis* is very variable, but it seems always to be distinguishable by the broader dark border on the hind wings above and by the relatively broad dark area between the row of spots and the submarginal light line on the hind wings below.

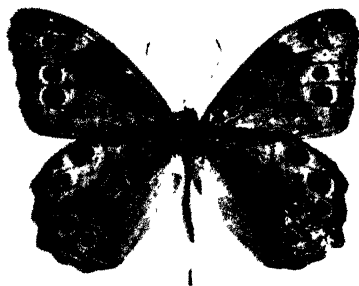
The interrelationships of the forms included in the genus *Enodia* are shown in the following key:

KEY TO THE FORMS INCLUDED IN THE GENUS *ENODIA*

- a*<sup>1</sup>. Male with the fore wings more pointed than those of the female, above with a broad furry band interrupted at the veins and by long triangles in the interstices; under side of fore wings with post-medial line irregular, interrupted above vein 6, outwardly oblique between veins 6 and 4, and usually slightly indented on vein 5; on hind wings below the fourth ocellus is smaller than the fifth-----*creola* (pl. 22, figs. 5, 6)
- a*<sup>2</sup>. Sexes practically alike; under side of fore wings with post-medial line more or less oblique from costa to vein 4, or just above it; on hind wings below the fourth ocellus is larger than the fifth-----*portlandia*
- b*<sup>1</sup>. Wings beneath with the rows of ocelli edged with white interiorly and more or less completely exteriorly; on the fore wings a white band runs from the costa to the region of the second ocellus, and beyond this a narrower white band runs from the costa to the upper part of the first ocellus; row of ocelli on under side of fore wings curved; second and third ocelli on under side of hind wings with elongate pupils, and fourth usually without a pupil.  
*portlandia portlandia* (pl. 22, figs. 3, 4)
- b*<sup>2</sup>. No white on wings beneath; row of ocelli on under side of fore wings below straight; all the ocelli on hind wings below have similar circular pupils.
- c*<sup>1</sup>. Dark border on hind wings above narrow and tapering anteriorly; on the hind wings below the dark band between the light line bordering the fourth and fifth spots and the submarginal light line is little, if at all, broader than the distance between the submarginal light line and the margin of the wing----*portlandia anthedon* (pl. 22, figs. 1, 2)
- c*<sup>2</sup>. Dark border on hind wings above broader and more uniform, not narrowing appreciably anteriorly; on the hind wings below the dark band between the light line bordering the fourth and fifth spots and the submarginal light line is broader, usually much broader, than the distance between the submarginal light line and the edge of the wing; ground color below browner and usually more uniform-----*portlandia borealis*

Although when typically developed the four forms included in the genus *Enodia* are quite different, three of them are very closely related. On the basis of the available material it appears that typical *portlandia* intergrades more or less with *anthedon*, and the latter intergrades with *borealis*, the relations between the three suggesting the relations between *Cercyonis alope pegala*, *C. a. alope*, and *C. a. nephele* occurring in the same general regions.

Richards said that *creola* intergrades with *portlandia*. It agrees, however, more closely with *anthedon*, as is evident from the straightness of the row of ocelli on the under side of the fore wings, the absence of clear white beneath, and the fact that all the ocelli on



1



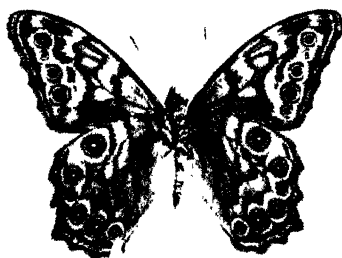
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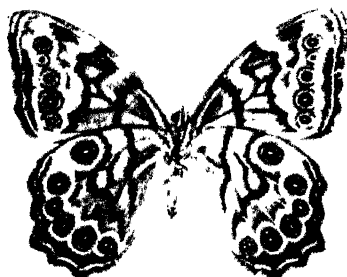
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4



5



6



7



8

- 1, 2. *Enodia portlandia anthedon*, new subspecies, ♂, type specimen. Lava, Sullivan County, N. Y., taken in June. U.S.N.M. no. 51137 (William Barnes coll.); upper (1) and under (2) sides.
- 3, 4. *Enodia portlandia portlandia* (Fabricius), ♀, Princess Anne, Va.; A. H. Clark, September 24, 1934. U.S.N.M.; upper (3) and under (4) sides.
- 5, 6. *Enodia creola* (Skinner): 5, ♂, western edge of Dismal Swamp, about 8 miles south of Suffolk, Nansemond County, Va., A. H. Clark, September 1, 1935, under side, U.S.N.M.; 6, ♀, western edge of Dismal Swamp, near Suffolk, Va., A. H. Clark, September 2, 1935, under side, U.S.N.M.
- 7, 8. *Brenthis hana*, new species, ♀, type specimen. Chanchamayo, Peru, on the eastern slope of the Andes. U.S.N.M. no. 51139 (William Schaus coll.); upper (7) and under (8) sides.



the under side of the hind wings are pupiled (compare figs. 2, 5, and 6, pl. 22). Judged from the specimens at hand, and from my experience with it in life, *creola* is readily distinguishable in both sexes from *portlandia* and its two forms and is a perfectly valid species.

For the privilege of studying the material in the National Museum collection I am under deep obligations to the late Foster H. Benjamin, who also was so good as to go over the literature with me and to assist me in other ways.

Dr. William Schaus has called my attention to an apparently new fritillary from Peru in his collection, now in the National Museum, and has been so kind as to suggest that I describe it. This new fritillary may be known as

**BRENTHIS HANA, new species**

PLATE 22, FIGURES 7, 8

*Description.*—Expanse, 41 mm. Distance from tip of fore wing to center of thorax, 24 mm. Antennae, 12 mm long.

Head thickly beset with long golden-brown hairs, becoming silky white on the frons and beneath and behind the eyes. Sides of palpi with a broad band silky white, heavily scaled and without hairs. Upper, inner, and lower sides of the palpi with very long golden-brown hairs, darkest above, lighter below, becoming whitish toward the base below. Antennae yellowish brown, the club darker.

Thorax black with numerous long golden-brown hairs. Abdomen above black with a sparse investiture of long golden-brown hairs, which laterally become brownish-gold scales; beneath the scales become more densely packed and lighter, and are interspersed with numerous long whitish hairs.

Fore wings roundedly pointed, the outer border convex in the apical third, becoming straight in the lower two-thirds. Hind wings well rounded, curving slightly more sharply around the end of vein 4 than elsewhere, and with a slight indication of an anal lobe.

Wings above dull yellowish fulvous, in the basal portion slightly infuscated and with numerous long golden-brown hairs, the veins and markings uniform dark yellowish brown.

Costal border of fore wings brown, with numerous fulvous scales in the proximal half. Outer margin of wings narrowly dark brown. Parallel to the dark border and near it on the hind wings is a narrow dark brown scalloped line, these two dark lines being separated by a fulvous line slightly wider than the inner dark line interrupted by the dark veins. This is repeated on the fore wings, but here the brown is more extensive so that the effect is that of a broad brown border with rather small crescentic fulvous spots that become still

smaller and more triangular apically. Each interspace, except the uppermost on the hind wings, bears a conspicuous oval dark spot distant from the inner dark line, in the middle of the interspace, about as far as that is from the outer edge of the wing. On the fore wing the spot between veins 2 and 3 is the largest, those on either side of this being slightly smaller, and the three nearer the apex much smaller, the middle one larger than the other two. On the hind wings the most anterior spot is very small, the next is larger, the following is small, though larger than the first, the two succeeding are large again, and the last is very small. Beyond the inner ends of these spots and the same distance from them as the submarginal line is a moderately broad continuous line, broadened at the veins and narrowed in the middle of the interspaces so that the dark submarginal spots lie each in the center of a light oval patch bordered by the dark veins and the concave borders of the lines on either side of them.

On the fore wings from the costal border somewhat beyond the middle a rather broad dark line runs directly inward to vein 5, then diagonally outward to vein 4, where it meets the line just described in a rather narrow point. Midway between the inner end of this line and the end of the cell a heavy dark line crosses the interspace between veins 4 and 3; just beneath the end of the cell a similar line crosses the interspace between veins 3 and 2; just touching the inner side of the lower end of the last a similar line, turning outward in its lower half, crosses the interspace between veins 2 and 1; just below the origin of vein 2 a similar line, turning inward instead of outward in its lower half, runs between veins 2 and 1. The two lines crossing the interspace between veins 2 and 1 are connected by a line parallel to the veins in the middle of the interspace. The end of the cell is crossed by a broad dark bar, broadest at the ends, with some light scales in the middle of its basal portion. In the outer half of the cell, touching the costal border though not quite reaching the vein below, is a broad 8-shaped figure with a few light scales in the middle of its lower half.

On the hind wings a well-defined, narrow, almost straight dark line runs from the basal third of the costal border parallel to the inner margin to vein 4, where it approaches very near the line within the row of submarginal spots; at this point it turns at approximately a right angle and runs toward the inner margin of the wing as far as vein 1. Within this line the markings of the wing are obscured by dark infuscation and long hairs; but the distal portion of the cell and the inner ends of the interspaces above and below the cell are light.

On the under side the fore wings are lighter and more yellowish than above, becoming pale reddish cinnamon apically. The markings

of the upper side are for the most part only very faintly indicated in slightly darker fuscous yellow; but the post-medial line is narrowly and sharply defined in dark brown, the spots in the three lowest interspaces are reproduced in dark brown, there is a narrow brown band across the end of the cell with a very fine curved line beyond it, and there is a chevron-shaped mark or incomplete circle in the middle of the outer half of the cell. The outer half of the costal margin, a narrow marginal line on the outer border, and the veins where they cross the pale reddish cinnamon apical area are silky white—almost silvery. A narrow but conspicuous line of the same silky white color runs from near the apex downward and sharply inward nearly to vein 6.

Hind wings beneath pale reddish cinnamon with the veins and a narrow marginal line conspicuously silky white and the costal margin light silky grayish. The markings of the upper side appear very faintly indicated on the lower. A long light fuscous-yellow band occupies the interspace beyond the end of the cell, running from near its outer end to just within the cell. The inner ends of the two interspaces beneath the end of the cell are dark brown, and the inner ends of the two interspaces above the end of the cell are obscurely dark brown.

*Type*.—U.S.N.M. no. 51139, from Chanchamayo, Peru, on the eastern slope of the Andes.







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## POLYCHAETOUS ANNELIDS FROM AMOY, CHINA

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C. C. A. MONRO (1934) has listed 40 species of polychaets from the coast of China, most of which were from Amoy and collected by Dr. T. Y. Chen, of the University of Amoy. The following report is upon a smaller collection of annelids, also made by Dr. Chen, from the neighborhood of Amoy and presented by him to the United States National Museum. It comprises but 31 specimens yet represents 21 species. Eight are apparently new: Two species of polynoids, *Lepidonotus minutus* and *Lepidasthenia ocellata*; a leodid, *Marphysa orientalis*; four nereids, *Nereis* (*Neanthes*) *linea*, *N.* (*Neanthes*) *orientalis*, *N.* (*Nereis*) *amoyensis*, and *N.* (*Leptonereis*) *distorta*; and a cirratulid, *Cirratulus branchiatus*. Only five—*Chloeia flava*, *Lysidice collaris*, *Marphysa sinensis*, *Nereis* (*Neanthes*) *oxypoda*, and *Nephtys sinensis*—are common to both collections.

The material on the whole is well preserved, but since in most cases only one individual of a species is present, there is a degree of uncertainty in the diagnosis of new species. Monro made similar comment on the collections he studied.

### Family AMPHINOMIDAE

#### Genus CHLOEIA Savigny

##### CHLOEIA FLAVA (Pallas)

*Aphrodita flava* Pallas, 1766, p. 97-102, pl. 8, figs. 7-11.

One specimen (Chen no. 21).

## Family POLYNOIDAE

## Genus LEPIDONOTUS Leach

## LEPIDONOTUS MINUTUS, new species

Two very small specimens, both tightly coiled so that measurements are hard to get, but they are about 7 mm long and 2.5 mm wide. From their small size I at first thought that they must be young, but since one contains mature eggs they obviously are adult. There are 12 pairs of elytra, completely covering the body.

The prostomium is longer than wide, its posterior margin overlapped by the nuchal fold, and is unusual in having no lateral bulgings or curves, the posterior diameter being only a little greater than the anterior. There are two pairs of subequal eyes, both pairs visible from above and situated rather in front of the middle of the prostomium (fig. 18, *a*). The cirrophore of the median tentacle is a trifle larger than those of the lateral, and its style extends only a short distance beyond the lateral ones. All are of uniform diameter except at the ends, where they narrow to form very delicate tips, those of the lateral ones being longer than that of the median. The basal two-thirds of each style is darker than the apex, but there is no definite pigmentation. The palps are not very large and reach to only a short distance beyond the tentacles. The tentacular cirri are very similar to the tentacles.

In the parapodium (fig. 18, *b*) is a heavy dorsal cirrus that extends beyond the setal lobe. The notopodium is recognizable only by the position of the acicula and the small tuft of setae arising direct from the body wall. The posterior lip of the neuropodium is truncate at the end, and from there its ventral margin extends downward as also a straight line, making an angle of about 45° with the end. The anterior lip, into which the acicula extends, is more conical. The ventral cirrus is slender and does not reach the end of the parapodium.

In the notopodium are two kinds of slender colorless setae. Both have slender stalks and carry two rows of fine-toothed plates. In one kind the stalk is short and ends in a rounded apex, being free from plates for an appreciable distance from the end. In the others, which are more than twice as long as the first, the stalk is drawn out into an exceedingly fine point, and toothed plates extend nearly or quite to the end. This point is difficult to determine with accuracy, since the stalk becomes very slender and the plates exceedingly small. It is quite possible, in fact, that the terminal denticulations are, as have been described in other species, fine teeth and not toothed plates. It may be that the shorter of these setae are really broken specimens of the longer type, but the ends seem too well rounded and entire for that. The neuropodial setae are of only one kind, all much heavier than the notopodial (fig. 18, *c*). They widen near the ends and then

narrow to a blunt point. On the concave surface of the terminal portion are about six toothed plates.

The elytra overlap on the mid-dorsal line of the body. They are oval in outline, and the greater part of the surface is covered by pig-

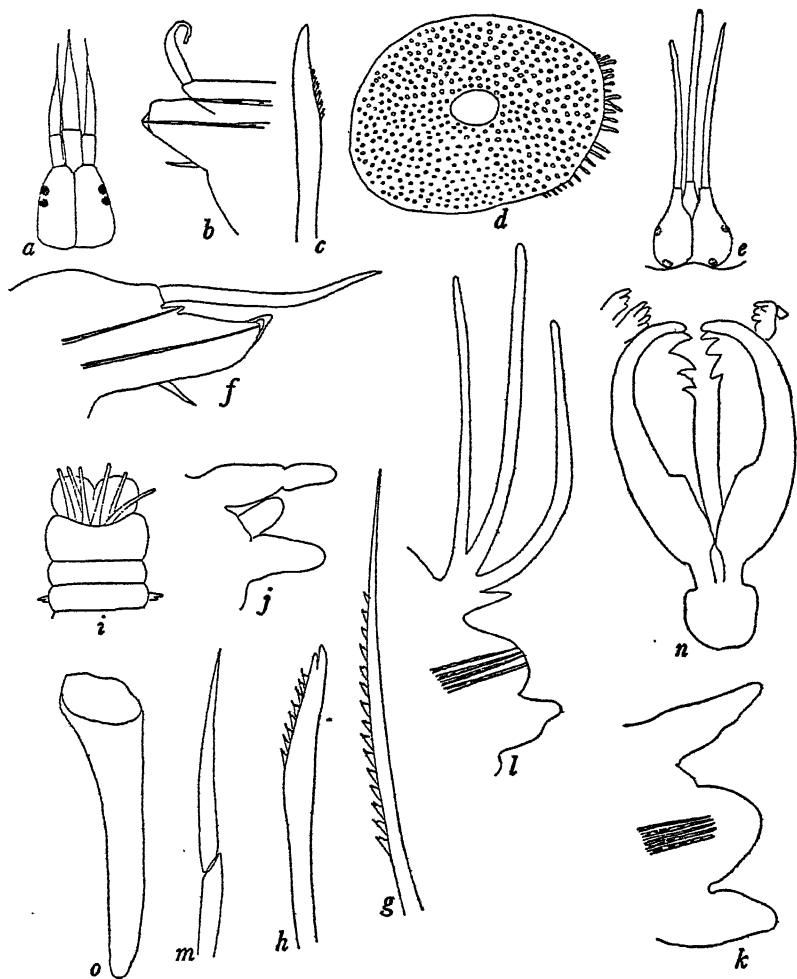


FIGURE 18.—New species of *LEPIDONOTUS*, *LEPIDASTHENIA*, and *MARPHYSA*.

a-d, *Lepidonotus minutus*: a, Prostomium,  $\times 20$ ; b, parapodium,  $\times 27$ ; c, seta,  $\times 185$ ; d, elytron,  $\times 45$ .

e-h, *Lepidasthenia ocellata*: e, Prostomium,  $\times 10$ ; f, parapodium,  $\times 15$ ; g, slender toothed seta,  $\times 185$ ; h, ventral seta,  $\times 68$ .

i-o, *Marphysa orientalis*: i, Anterior end,  $\times 4$ ; j, first parapodium,  $\times 22.5$ ; k, tenth parapodium,  $\times 22.5$ ; l, middle parapodium,  $\times 18$ ; m, compound seta,  $\times 185$ ; n, maxilla,  $\times 9$ ; o, half of mandible,  $\times 9$ .

ment patches, which are denser near the point of attachment and extend to the outer lateral margin, leaving the other margins clear (not shown in fig. 18, d). Blunt spines are scattered at about equal

distances over the entire surface (fig. 18, *d*). On the posterior margin is a row of papillae of varying sizes, but the rest of the margin is entire.

*Type*.—U.S.N.M. no. 20112 (Chen no. 19).

Genus **LEPIDASTHENIA** Malmgren

**LEPIDASTHENIA OCELLATA**, new species

The type and only specimen is 85 mm long and has a prostomial width of 1 mm. From here the body widens to the tenth somite, which is 5 mm wide. The somites immediately behind the tenth show a slight narrowing, and this narrower width is retained throughout the greater part of the body, the narrowing at the region of the pygidium being rather abrupt. Remains of three very slender anal cirri persist in the specimen.

The head region is covered by two translucent white elytra, which extend from their attachment on the second setigerous somite to about half the length of the terminal joints of the tentacles. Each half of the prostomium is flask-shaped, the "shoulder" of the flask being a little higher on the inside than on the outside (fig. 18, *e*) and each half is continued to form a cirrophore for the corresponding tentacle. The tentacular style is slender, about twice as long as the prostomium, and acuminate at the tip. The cirrophore of the median tentacle is a little stouter than that of the laterals, and the style is somewhat longer. The palps are relatively rather slender. The tentacular cirri are very similar to the median tentacle in size and form. All cirri are slender and sharp-pointed and somewhat of a translucent white in color, although especially toward the ends they carry patches of porcelain white.

Ventrolateral to a line drawn from one eye to the other on either side (in preserved material) is a brownish pigment patch, and the entire dorsal prostomial surface as far as the cirrophores has a faint brown tint. On the inner side of the first parapodium where this parapodium comes into contact with the side of the prostomium are a number of fine dark lines forming a definite pigmented patch. On the dorsal surface of the first setigerous somite is a pigment patch, and fine pigmented lines occur on alternate somites (the ones that do not carry elytra). These at first are somewhat irregular, but by the eighteenth somite the dorsal surfaces have definite pigment patches formed of fine lines arranged longitudinally. A very little pigment occurs at the base of each elytraphore. Beginning with the first somite the dorsal surface between the above mentioned pigment patches is colorless but has pigment on either side. This colorless middle region is most noticeable in the first two somites, and by the fifth the pigment has covered the middle region as well. The general

effect is that of a dorsomedian dark area covering more than half of the dorsal surface, the pigment being in the form of very fine lines drawn transversely. By the fifteenth somite the lateral margins of this area have become noticeably darker than the remainder. This pigmentation continues throughout the greater part of the body but later gradually disappears. The appearance of the living animal must have been considerably affected by the pigmentation of the elytra. The first two of these remain and are colorless and translucent. Most later ones are lost, but the eighth remains, and in this, while in general the translucence remains, there is a patch of pigment extending from its base halfway to its outer margin. The elytron is sufficiently translucent to produce an ocellated effect by the colorless outer end of the elyrophore, bounded on its inner margin by a pigmented band.

The elytra are all nearly circular in outline and have perfectly smooth margins. They occur throughout the body, at first alternating with cirri but posteriorly several cirrus-bearing somites may lie between two of the elytron carriers.

In a parapodium the dorsal cirrus (fig. 18, *f*) is very prominent, extending considerably beyond the end of the setal lobe. The notopodium is rudimentary, having an acicula but no setae. The neuropodium ends in two lips of which the anterior is the more pointed and the longer. Between the lips is a rounded lobe into which the end of the acicula extends. From the dorsal to the ventral part of the setal lobe is a definite change in the character of the setae. Dorsally there are a few (3 in the one drawn) slender sharp-pointed setae (fig. 18, *g*) carrying on one margin a row of fine-toothed plates. Just ventral to these are much heavier setae, nearly twice as thick as to shaft, curved toward the ends and bifid at the apex. These also carry toothed plates (fig. 18, *h*). Ventrally this type of seta becomes smaller, those at the very lower end being hardly thicker in the shaft than the slender dorsalmost setae. The ventral cirrus is small and located at about half the length of the parapodium from its base.

*Type*.—U.S.N.M. no. 20113 (Chen no. 32).

## Family ACOETIDAE

### Genus PANTHALIS Kinberg

#### PANTHALIS PANAMENSIS Chamberlin

*Panthalis panamensis* CHAMBERLIN, 1919, pp. 86-89; pl. 11, figs. 4-8; pl. 12, figs. 1-6.

An incomplete fragment 25 mm long (Chen no. 47). I was unable to find all the kinds of setae described by Chamberlin as occurring in

the first setigerous somite, but probably this was due to the poor condition of the specimen and the loss of some of the somites.

### Family LEODICIDAE

#### Genus DIOPATRA Audouin and Milne Edwards

##### DIOPATRA NEAPOLITANA Chiaje

*Diopatra neapolitana* CHIAJE, 1841, p. 97.—FAUVEL, 1932b, p. 144; 1933, pp. 28–37, fig. 4, a–d.

One specimen (Chen no. 34).

#### Genus LYSIDICE Savigny

##### LYSIDICE COLLARIS Ehrenberg, Grube

*Lysidice collaris* GRUBE, 1868, p. 633; 1869, p. 495.—VON MARENZELLER, 1879, pp. 136–137, pl. 5, figs. 2, 2A, 2B.

Two specimens (Chen nos. 28, 35), one incomplete, identified from von Marenzeller's description.

#### Genus LUMBRINEREIS Blainville

##### LUMBRINEREIS HETEROPODA (von Marenzeller)

*Lumbriconereis heteropoda* VON MARENZELLER, 1879, pp. 138–139, pl. 5, figs. 4, 4A, 4B; pl. 6, figs. 1, 1A, 1B.

A single incomplete specimen (Chen no. 33) retaining about 50 of the anteriormost somites. The only differences that I could discover between this and von Marenzeller's description are that the teeth on the large maxillary plate are heavier than in the Japanese specimen and that hooked setae occur in somites anterior to the thirty-fifth.

#### Genus MARPHYSA Quatrefages

##### MARPHYSA SINENSIS Monro

*Marphysa sinensis* MONRO, 1934, pp. 367–369, fig. 5.

The two specimens (Chen no. 45) agree with Monro's description in the apparent absence of pectinate setae in the anterior somites and in the presence of compound setae whose terminal joints show a faint longitudinal grooving (Monro's fig. 5E). In other species of *Marphysa* the pectinate setae are hard to find in anterior somites, so that the peculiar compound setae are possibly the only essential difference between this species and *M. belli* Audouin and Milne Edwards. It might be questioned if this difference is of specific value and whether *M. sinensis* should not rather be listed as a variety of *M. belli*.

##### MARPHYSA ORIENTALIS, new species

The type and only specimen is 200 mm long and has a prostomial width of 3.5 mm and a peristomial width of 5 mm. From the prostomium the body gradually widens to about the fortieth somite,

where it is 8 mm in diameter. Throughout the rest of the body the diameter is somewhat less than this, and at the pygidium there is an abrupt narrowing.

The prostomium (fig. 18, *i*) is distinctly bilobed, the dorsal longitudinal depression extending about halfway to the peristomial border. The outer right tentacle has been lost, but the others are all about of the same size, only a little longer than the prostomium. Setigerous somites 2 to 4 are all of about the same length, about half that of the peristomium. Later ones are about half as long as these. In the preserved material the body color is brown with marked iridescence.

The first parapodium (fig. 18, *j*) has its setigerous portion a little posterior to the bases of the dorsal and ventral cirri and carrying a prominent bundle of compound setae, which extend beyond its dorsal and ventral surfaces. There are three heavy aciculae. The dorsal cirrus is about twice as long as the setal lobe, its apex bluntly rounded. The ventral cirrus is about three-fourths as long as the dorsal but is broader and its apex blunter. In the tenth parapodium (fig. 18, *k*) the setal lobe is relatively larger than in the first and is in the form of a rounded lobe from whose anterior face a tuft of setae extends dorsally and ventrally as well as along the face of the lobe. The dorsal and ventral cirri are, relative to the setal lobe, much slenderer than in the first but retain their relative sizes with respect to one another. Aciculae make up a dense black mass in the setal lobe, coming to the surface among the setae. The ventral setae of the setal tuft are compound, the dorsal one simple, and the ventralmost ones are quite short, while those at the top of the bundle extend beyond the ends of the dorsal cirrus. A parapodium from the middle of the body (fig. 18, *l*) has a less prominent setal lobe than is the case in the anterior ones and the setae are fewer in number. The ventral cirrus is an inconspicuous cone attached to the end of a ventral swelling, which is fused for nearly its whole length to the ventral face of the setal lobe. In addition to setae like those found farther forward, there are pectinate ones in the dorsal part of the bundle. The dorsal cirrus is a slender cone inserted much above the setigerous portion and attached to the base of the prominent gill.

In the type the thirty-fifth setigerous somite has one very small gill filament on the left side, but the series really begins on the forty-fifth, and they extend to within about 30 somites from the pygidium. I saw none that had more than three filaments, and posteriorly they have only one. There is one pair of small anal cirri.

The simple setae are relatively rather heavy in the stem and are long and gently curved to sharp points. Compound ones (fig. 18, *m*) have the terminal joint long and curved and tapering to sharp points. Aside from the jointing the general contours of the two kinds of setae are similar.



The maxillae are very dark. The carrier of the forceps is nearly circular at its base and is attached to the forceps by narrow stems (fig. 18, *n*). Each of the paired plates has three heavy teeth, the unpaired one has four, the right distal has four, and the left distal has three. The mandibles are dark brown and have slender stems (fig. 18, *o*). The beveled portions are covered with a thin whitish incrustation.

*Type*.—U.S.N.M. no. 20114 (Chen no. 25).

## Family NEREIDAE

### Genus NEREIS Cuvier

#### NEREIS (NEANTHES) OXYPODA von Marenzeller

*Nereis (Alitta) oxypoda* VON MARENZELLER, 1879, pp. 120–122, pl. 2, fig. 3.

A single specimen (Chen no. 27) lacking the posterior region. The pharynx was retracted, but so far as could be determined from dissection the paragnath formula agrees better with von Marenzeller's original description than with that of Fauvel, who reported it from the Gulf of Pei Tcheu Ly (1933, p. 22).

#### NEREIS (NEANTHES) LINEA, new species

Body length of type, 180 mm; prostomial width, 2.5 mm; peristomial width, 4.5 mm. At the sixth setigerous somite the body width (counting the parapodia) is 8 mm. From the fourteenth setigerous somite the body gradually narrows to the pygidium, which is 1 mm wide and carries one pair of long anal cirri.

The prostomium (fig. 19, *a*) is a little longer than its basal width and widens slightly from its posterior border to just in front of the anterior pair of eyes, where it narrows to about two-thirds of its basal width. It is difficult, however, to determine the precise boundaries of the prostomium, because it merges so gradually on either side into the basal joint of the palp. The anterior end is rather narrow, and the two conical tentacles are situated less than their own diameter apart. In the type the palps are bent ventrally and so do not show well in a dorsal view. The basal joint is heavy, the terminal one a mere knob, the basal joint extending in front of the tentacles. The posterior dorsal tentacular cirrus extends to the sixth setigerous somite, the anterior dorsal to the second, and the posterior ventral to the first, while the anterior ventral is shorter than the peristomium, all being very slender. On its lateral margins the peristomium is about two-thirds as long as the prostomium, while on the mid-dorsal line it is about half as long as on the margins. Setigerous somites 1 to 4 are about two-thirds as long as the mid-dorsal length of the peristomium, while later ones increase to twice this length. This latter length is continued throughout the greater part of the body. On the peristo-

mium and first 15 setigerous somites there are on either side 8 to 10 fine brownish lines starting at the posterior border and running antero-dorsally. The dorsalmost of these bend toward the dorsal mid line and do not reach the anterior margin. Others reach the margin, but

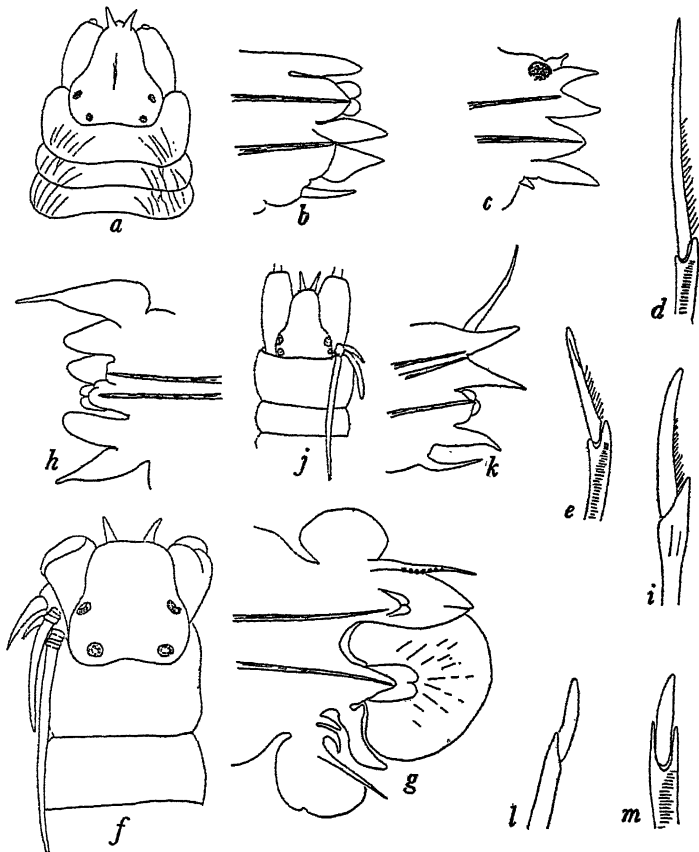


FIGURE 19.—New species of *NEREIS*

*a-e, Nereis (Neanthes) linea*: *a*, Anterior end,  $\times 5$ ; *b*, tenth parapodium,  $\times 12$ ; *c*, posterior parapodium,  $\times 12$ ; *d*, seta,  $\times 300$ ; *e*, seta,  $\times 300$ .

*f-i, Nereis (Neanthes) orientalis*: *f*, Anterior end,  $\times 5$ ; *g*, epitokous parapodium,  $\times 8$ ; *h*, third parapodium,  $\times 12.5$ ; *i*, seta,  $\times 50$ .

*j-m, Nereis (Neanthes) amoyensis*: *j*, Anterior end,  $\times 7.5$ ; *k*, thirtieth parapodium,  $\times 45$ ; *l*, seta,  $\times 300$ ; *m*, seta,  $\times 300$ .

the lines of successive somites do not unite. A few are forked toward their anterior ends. In the first setigerous somite about one-fourth of the mid-dorsal area is free from these lines, and this free portion widens in later somites to occupy about half of the dorsal surface. Behind the fifteenth somite the lines gradually shorten and are not found behind the twenty-second.

The first parapodium is uniramous and has a large ovate dorsal lip and a long, slender dorsal cirrus. An acicula comes to the surface at the apex of the conical posterior lip of the setal lobe. There are two subequal, rounded anterior lips. The tenth parapodium (fig. 19, *b*) has well-developed notopodia and neuropodia, the notopodium being essentially similar to the first parapodium. The neuropodium has practically no posterior lip to the setal lobe, but there are two prominent anterior ones. The ventral cirrus is very slender, extending about halfway to the tips of the setal lips. A later parapodium (fig. 19, *c*) has on the notopodium a conical dorsal, and on the neuropodium a ventral, lip. The dorsal cirrus is very small, and just inside it is a prominent pigment patch. The ventral cirrus is also very small. Two kinds of setae are found throughout the body. The first (fig. 19, *d*) have long pointed terminal joints, which carry hairlike processes along one margin. The others (fig. 19, *e*) have much shorter terminal joints, which, however, have the same arrangement of hairlike processes. The end of the terminal joint is bluntly rounded and appears to be slightly twisted. In some cases it seemed as if there were setae having short denticulations instead of the hairs, but probably these were broken.

The paragnath arrangement is as follows: I, 4, in a group, 1 larger in front and 3 smaller behind; II, arcs of irregularly arranged 2 rows, the 4 nearest the middle in each row being larger than the others; III, a roughly circular diffuse patch of paragnaths; IV, 2 rows, the paragnaths slightly larger than in III; V, 3 in a longitudinal row; VI, 2 or 3 large paragnaths, transversely arranged; VII and VIII, a double continuous row.

*Type*.—U.S.N.M. no. 20115 (Chen no. 29).

**NEREIS (NEANTHES) ORIENTALIS, new species**

The single specimen is incomplete, but since the diameter at the posterior end is only 4 mm it seems probable that not much of the body has been lost. What remains is 76 mm long and has a prostomial width of 3.5 mm.

The prostomial width is about equal to its length, and its posterior margin has rounded ends and a slight emargination in the mid-dorsal line. The diameter of the posterior margin is retained as far as just in front of the anterior eyes, where it narrows by about the diameters of the two eyes. From here the lateral margins extend nearly straight forward to the broadly rounded anterior lateral angles (fig. 19, *f*). In the middle of the dorsal surface is a slitlike longitudinal depression, which may have been caused by the preservation methods. The eyes are nearly equal in size, one pair located as mentioned above, the other near the posterior margin, the lenses of the posterior pair looking dorsally, those of the anterior anterolaterally. The tentacles are not

more than one-fifth the length of the prostomium and are conical in outline. They are separated by more than their own diameter from each other. The prostomial region is more or less distorted by the partially protruded pharynx, and the palps have an abnormal appearance due either to this pressure or to imperfect preservation. In their present condition the basal joint of each palp is about half as wide as the prostomium and is much wrinkled, while the terminal joint is a mere button inserted in the end of the basal (not shown in fig. 19, *f*). The longest tentacular cirrus reaches to the third setigerous somite, the next longest to the second, the next to about the middle of the first, and the fourth is shorter than the peristomium. The specimen is in the epitokous condition, which does not seem to have affected the anterior region but shows first in parapodial changes at the region of the twenty-fifth parapodium.

A parapodium taken from the middle of the epitokous region (fig. 19, *g*) is 6 mm in vertical diameter. The setal portion of the notopodium ends in two lobes of which the posterior one is itself bilobed and a little longer than the anterior. An acicula comes to the surface at the ventral face of the anterior lobe, and a fan-shaped bundle of setae, attached to the anterior side of the lobe near its base, covers the whole anterior face of the notopodium. A two-lobed "fan" is attached to the posterior parapodial surface, each lobe narrowing toward the end, so that as the two lie in contact with each other the whole has an ovate outline. Another fan-shaped lobe covers the dorsal surface of the notopodium, its point of attachment being median to that of the dorsal cirrus. The dorsal cirrus extends beyond the notopodial apex and has the peculiar lobed border characteristic of the epitokous phase, except that instead of being mere crenulations they are eight definite rounded thickenings of the surface. The terminal lobes of the neuropodium are quite similar to those of the notopodium except that they are larger. There is also the vertical row of setae and the large anterior "fan." Attached to the lower surface of the neuropodium is a process whose outline might be described as a distorted oblong. The ventral cirrus is about as long as the notopodium and has a broad fan attached to its base. On its dorsal surface are two peculiar finger-shaped processes.

Anterior parapodia (fig. 19, *h*) have thick, heavy dorsal and ventral lips. The notopodium carries a posterior lobe similar in outline to the dorsal lip but is not quite so large and there is no anterior lobe. The neuropodium has bilobed anterior and posterior terminal lips. The dorsal cirrus is heavier than the dorsal lip, and toward the apex it terminates in a very narrow portion. The ventral cirrus is also heavy, its base narrower than its median portion but its apex narrow. There is a single acicula in each lobe.

In anterior somites the neuropodial setae are much larger than the notopodial, their basal joints homogomph and markedly cross striated. Their terminal joints are long, gently curved to sharp apices, and finely denticulated along the concave border. In the notopodium are two kinds of setae neither of which protrudes from the surface as much as do the neuropodial. Those of the ventral part of the tuft are similar to the neuropodial. Those of the dorsal part have heterogomph transversely striated basal joints, the terminal joints being short and blunt-ended and carrying a row of stiff spines along one margin (fig. 19, *i*). The setae of the posterior portion of the body have the broad paddle-shaped terminal joints characteristic of the epitokous phase.

The paragnath arrangement is: I, 2, one behind the other; II, 8 pairs, each being almost dumb-bell shaped, the first 6 pairs larger than the others; III, numerous paragnaths arranged in 4 transverse rows, with 4 smaller ones at either end; IV, 4 or 5 large paragnaths with scattered smaller ones in front and behind; V, 1 large and several smaller ones; VI, 2 large ones; VII and VIII, 2 irregular transverse rows. Each jaw is a curved dark-brown plate without any marginal denticulations.

*Type*.—U.S.N.M. no. 20116 (Chen no. 26).

**NEREIS (NEANTHES) AMOYENSIS, new species**

The single specimen is incomplete, retaining the first 45 somites, which in length measure 27 mm. The prostomial width is 1 mm, the peristomial 1.5 mm. The widest region is in the neighborhood of the tenth setigerous somite.

The prostomium (fig. 19, *j*) has a length a little greater than its breadth, and the eyes are separated from each other by less than their own diameters. The prostomium narrows immediately in front of the anterior eyes, about one-third of its length from the posterior border. The tentacles are less than one-third as long as the prostomium and are separated at their bases by a distance less than their own diameters. The basal joints of the palps extend to the ends of the tentacles. In both palps the terminal joints are broken but look as if originally they were rather narrow cylinders. The tentacular cirri are slender and short, the longest barely reaching the anterior border of the third setigerous somite. All other tentacular cirri are shorter than the peristomium.

The prostomium is twice as long as the first setigerous somite. Later somites show slight increases in length up to the tenth, this latter length being retained throughout the rest of the fragment.

The thirtieth parapodium (fig. 19, *k*) has conical lips on the notopodium, the setal portion not showing as a definite lobe. The dorsal cirrus is very long and slender, and there are two aciculae in the noto-

podium. The neuropodium has a conical presetal and two rounded postsetal lobes and a single acicula. There is one sharp-pointed ventral lip much like those of the notopodium in outline and a ventral cirrus reaching nearly to the end of the lip.

There are three kinds of compound setae. The first have very slender terminal joints that are faintly serrated along the slightly curved border; the second (fig. 19, *l*) have short terminal joints bluntly rounded at the ends and without teeth; and the third, stout setae found only in the notopodium, have the terminal joint inserted in a notch in the end of the basal (fig. 19, *m*).

The paragnath arrangement is: I, 1 very dark tooth; II, irregular groupings of 2 or more; III, a transverse group of 15 or so, the outer ends of each group being wider than in the middle; IV, a single irregular row; V, absent; VI, a rounded patch of 6 to 8; VII and VIII, together a rather broad irregular patch with a single row of larger paragnaths anterior to the others.

*Type*.—U.S.N.M. no. 20117 (Chen no. 31).

**NEREIS (LEPTONEREIS) DISTORTA, new species**

A single male specimen in the epitokous phase. The body is not complete, but from the small size of the posterior end of the fragment it appears that not much has been lost. It is 70 mm long, with a diameter of 8 mm at the seventh parapodium. This diameter is retained for about 15 somites, and then there is a gradual decrease in width toward the posterior end. The prostomial width is 2 mm, the peristomial 3.5 mm. The three somites following the peristomium are scarcely wider than it and are very short (fig. 20, *a*). From the fourth to the eighth setigerous somites there is a rapid increase in length and breadth, the eighth being two and a half times the width and three to four times the length of the peristomium. Possibly some of these differences are due to distortion caused by preservation methods.

The prostomium (fig. 20, *a*) is wider than long, with prominent eyes of which the anterior pair are more than twice as large as the posterior and have lenses pointed anterolaterally. The posterior eyes are distant by about their own diameter from the anterior, and their lenses point dorsally. The posterior margin of the prostomium is overlapped dorsally by the peristomium, which in the specimen partly covers the eyes. In figure 20, *a*, this is drawn as if turned back. The posterior margin of the prostomium is straight and its lateral angles rounded. It is widest just in front of the anterior eyes and then narrows by about the eye diameters. It is rounded anteriorly and divided into two parts by a definite but not very deep dorsal longitudinal incision and an anterior marginal invagination. The tentacles are conical, colorless, about one-eighth as long as the

prostomium, and situated near the outer anterior prostomial angles. The basal joint of the palp is long and cylindrical and extends almost to the ends of the tentacles. The terminal joint is a mere knob. The dorsal posterior tentacular cirrus extends to the middle of the sixth setigerous somite, the dorso-anterior to the fourth, the ventro-posterior to the third, and the ventro-anterior to the first. The peristomium is hardly more than one-third as long as the prostomium and is a trifle longer in the mid-dorsal line than on either edge.

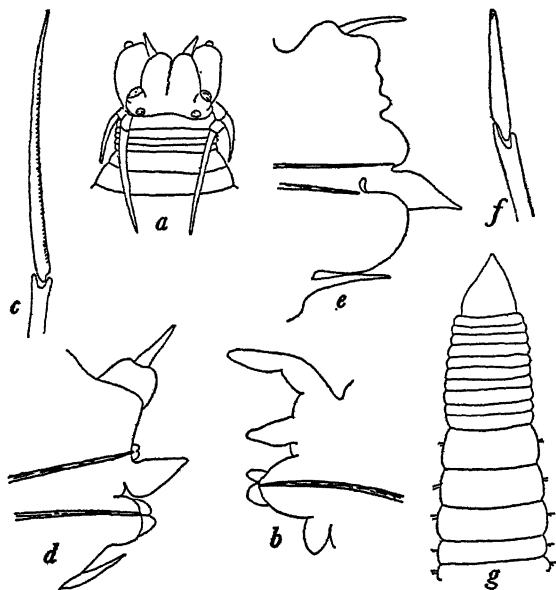


FIGURE 20.—New species of NEREIS and CIRRATULUS

*a-f, Nereis (Leptonereis) distorta*: *a*, Anterior end,  $\times 5$ ; *b*, first parapodium,  $\times 18$ ; *c*, anterior seta,  $\times 300$ ; *d*, eighteenth parapodium,  $\times 12$ ; *e*, thirtieth parapodium,  $\times 12$ ; *f*, second form of seta,  $\times 300$ .

*g, Cirratulus branchiatus*: Anterior end,  $\times 10$ .

Except for the peristomium and first three setigerous somites, the body is much distended with sperm. The first parapodium (fig. 20, *b*) has a prominent dorsal cirrus and conical notopodial lip but no setal lobe or acicula. The neuropodial setal lobe has rounded anterior and bifid posterior lips and a single acicula. The setae are all compound and homogomph, the terminal portion slender and elongated but not much curved, and finely toothed along one margin (fig. 20, *c*). Since from most of these the terminal joint has been broken, I am unable to say whether they are all alike. A notopodial acicula first appears in the third parapodium and is accompanied by a few setae essentially like those of the neuropodium but much smaller, so that under a hand lens the neuropodial setae appear to be the only ones

present. In this somite also the dorsal cirrus has a heavy basal joint to which the cirrus proper is attached. This becomes much more marked in later somites. There is a short ventral cirrus.

In the eighteenth parapodium (fig. 20, *d*) there is a notopodial acicula and small bilobed posterior lip on the setal lobe. The dorsal cirrus is attached to the basal lobe above mentioned and there is a lip just ventral to the setal lobe. The neuropodium is not noticeably different from the first, but the ventral cirrus is slender. The thirtieth parapodium (fig. 20, *e*) has prominent bundles of setae on both neuropodium and notopodium, extending fanwise so that they overlap. Dorsal to the notopodial setal lobe the parapodium is decidedly elevated, and the dorsal cirrus lies in a depression on its upper margin. The conical lip seen in earlier somites is still present, ventral to the setal lobe, which has rounded anterior and posterior lips of which the former is the longer. The neuropodial setal lobe also has two rounded lips, and the ventral cirrus is much as it was in the eighteenth parapodium.

In the eighteenth parapodium are a few notopodial setae of the general form of figure 20, *f*. In the neuropodium are two tufts, one above and one below the acicula. The majority are as shown in figure 20, *c*. In each tuft are smaller numbers of a second form (fig. 20, *f*). In these the basal joint is heterogomphous, the terminal joint short, blunt-pointed, and without teeth.

In the subgenus *Leptonereis* there are no paragnaths on the pharynx. In *N. (L.) distorta* the jaws are dark brown, gently curved, and each with about 16 subequal teeth.

*Type*.—U.S.N.M. no. 20118 (Chen no. 22).

## Family GLYCERIDAE

### Genus GLYCERA Savigny

#### GLYCERA ROUXII Audouin and Milne Edwards

*Glycera rouxii* AUDOUIN and MILNE EDWARDS, 1834, p. 242-243, pl. 6, figs. 5-10.—FAUVEL, 1933, p. 43.

Fauvel (1933, p. 43) decided that von Marenzeller's *G. decipiens* (1879, pp. 140-142, pl. 6, fig. 3) is synonymous with *G. rouxii*, and since he had an opportunity of comparing the Chinese with the Mediterranean specimens his identification probably is correct. My single specimen (Chen no. 24) agrees with Marenzeller's and Fauvel's descriptions but differs in some respects from the diagnosis given by Audouin and Milne Edwards.



## Family NEPHTHYDIDAE

## Genus NEPHTHYS Cuvier

## NEPHTHYS SINENSIS Fauvel

*Nephtys sinensis* FAUVEL, 1932a, p. 536, fig. 1, a-c; 1933, pp. 40-42, fig. 5.—  
MONRO, 1934, pp. 363-365, fig. 2.

A single specimen (Chen no. 49) broken in the middle but with apparently none of the body lost. I have listed it as *N. sinensis* following Monro, because the prostomium structure agrees perfectly with his description, and the differences between his figure of the parapodium and mine might be accounted for by distortions due to preservation methods. His figure of the parapodium, however, is quite different from Fauvel's, the differences being as great as are those separating other species of the genus. It seems probable that a study of a larger number of specimens would demonstrate that this is a new species.

A prostomial peculiarity in my material not mentioned or figured by Monro is that the anterior tentacles can be traced as thickenings for a considerable distance back on the surface of the prostomium, and the anterior prostomial area lying between these tentacles is so translucent that it looks like a web connecting the tentacles.

## Family CIR RATULIDAE

## Genus CIR RATULUS Lamarck

## CIR RATULUS BRANCHIATUS, new species

The body of the type and only specimen is about 45 mm long, the peristomial diameter being slightly greater than the prostomial, which is about 0.75 mm. The somites following the peristomium show a gradual increase in width, the greatest width being reached posterior to the middle of the body where for about 25 somites the width is 3 mm. Behind this there is a gradual decrease to the very narrow pygidium. It is not possible to determine to what extent these differences are due to the effects of preserving fluids.

The prostomium (fig. 20, *g*) is conical, its width a little less than its length and with no eyes visible. Because of numerous surface wrinklings, which exactly imitate somite boundaries (fig. 20, *g*), the latter are difficult to determine, but apparently there are three achaetous somites, this achaetous portion being about twice as long as the prostomium. On its anterior border it is a little wider than the prostomium, and this width hardly changes to its posterior border. The first three setigerous somites are each about one-fourth as long as the achaetous portion, the fourth and fifth are each about one-third shorter than these, the sixth and seventh are still

shorter, and succeeding ones are not more than one-third to one-half the length of the first setigerous somite.

Gills appear on the first somite, and while only a few are retained they apparently occur throughout the body, some of the posterior ones being longer than the body diameter. The tentacles lie in a transverse row on the dorsal surface of the fifth setigerous somite. One of the these (unfortunately broken off during examination) was 0.4 mm in diameter at the base, and its length was several times the diameter of the body. Owing to extensive coiling the precise length was not possible to get. Probably originally there were on either side one large tentacle and several smaller ones, the whole forming a continuous band across the dorsal surface of the somite.

Setae of anterior somites are very slender and extend much farther from the body surface than do those of later somites. They curve gently to an acute point, and in some very minute roughnesses may be seen along one margin. Occasionally these seem regular enough to be listed as denticulations, but usually they are very irregular and may in most cases be merely minute grains of foreign matter attached to the seta. On either side of the posterior somites are two setal tufts composed of about six moderately heavy spines, which narrow slightly and then curve toward the blunt end, and a few slender setae similar to those in anterior somites but much less prominent.

*Type*.—U.S.N.M. no. 20119 (Chen no. 15).

## Family MALDANIDAE

### Genus EUCLYMENE Verrill

#### EUCLYMENE ANNANDALEI Southern

*Euclymene annandalei* SOUTHERN, 1921, p. 648, pl. 28, fig. 22, a-g; pl. 29, fig. 22, h-k.

*Clymene (Euclymene) annandalei* FAUVEL, 1932b, p. 199; 1933, p. 51.

In only three points does this specimen (Chen no. 9) differ from Southern's description. The first is that there are two instead of a single uncinus in the neuropodium of anterior somites. According to Chamberlin (1919, p. 409) *Euclymene* has only one of such setae, the alternative being *Paraxiothea* Webster, in which they are "numerous." Since two can hardly be considered as numerous, I have listed them as *Euclymene*. Fauvel calls it the genus *Clymene*, a name that is preoccupied (Chamberlin, 1919, p. 410).

A second difference is that the dorsal setae in the posterior somites remain in a tuft and do not arch over and around the ventral. A third is that while Southern found 14 to 24 cirri on the margin of the anal funnel, this has 30. Since none of these characters seems to be of specific importance, I have listed the specimen as above.

## Family SABELLIDAE

## Genus SABELLASTARTE Krøyer

## SABELLASTARTE FUSCA (Grube)

*Sabella fusca* GRUBE, 1869, p. 516.—McINTOSH, 1885, pp. 491-492, pl. 52, fig. 3; pl. 30A, figs. 4-6.

I have identified this specimen (Chen no. 16) from McIntosh's description. Having only one form of seta in the anterior tori, it is a *Sabellastarte* rather than a *Sabella*.

## Genus DASYCHONE Sars

## DASYCHONE ORIENTALIS McIntosh

*Dasychone orientalis* McINTOSH, 1885, pp. 498-500, pl. 52, fig. 5; pl. 30A, figs. 19-21; pl. 39A, fig. 4.

The identification of this specimen (Chen no. 16) is made with some hesitation, since McIntosh's description was based on an imperfect specimen and was therefore incomplete. In essential respects it agrees with his original description.

## Family TERESELLIDAE

## Genus THELEPUS Leuckart

## THELEPUS JAPONICUS von Marenzeller

*Thelepus japonicus* VON MARENZELLER, 1884, pp. 208-209, pl. 2, fig. 4

A single specimen (Chen no. 12).

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## A STUDY OF THE FOSSIL HORSE REMAINS FROM THE UPPER PLIOCENE OF IDAHO

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### INTRODUCTION

THE RECORD of fossil horses in North America is one of the most interesting and best known of the groups of mammals. The development of the horse through Tertiary time appears to have been most nearly continuous on this continent, stages of which are among the best represented of the mammals. Development of the horse has been relied on to a considerable extent as a guide to the various Cenozoic horizons in terrestrial deposits. In the study of this group much interest has been attached to the occasional discovery of intervening types bridging previous hiatuses in the sequence. *Plesippus* apparently bridges such a gap in the developmental sequence between earlier Pliocene horses and Quaternary *Equus*. *Plesippus shoshonensis*, the species encountered in the late Pliocene deposits near Hagerman, Idaho, appears to be an advanced stage in this genus, bordering on the equine types of recognized Pleistocene age.

Attention of the United States National Museum was first directed to the occurrence of fossil horse remains in the vicinity of Hagerman in 1928 by Dr. H. T. Stearns, of the United States Geological Survey, who was at the time engaged in a study of the geology and ground water of the region. To Elmer Cook, a resident of Hagerman and an amateur collector, belongs credit for discovering the fossils and

bringing them to the attention of Dr. Stearns. A small but interesting collection of horse remains sent to the National Museum by Stearns resulted in the Smithsonian Institution sending the late Dr. J. W. Gidley to the locality in the following year and again in 1930. In 1931 the expedition was in charge of N. H. Boss, and the quarry opened by Gidley was further developed and additional material obtained. In 1934 I was permitted to continue the program in southern Idaho in order to obtain a better representation of the associated fauna from beds in the vicinity of the quarry and to make another collection of horses.

The principal quarry is located on the west slope of a hill or ridge projecting southward from the desert rim into a deeply dissected embayment (pl. 23, fig. 1). The hill is in T. 7 S., R. 13 E., Twin Falls County, on the west side of the Snake River, opposite the town of Hagerman. In addition to the main quarry several smaller quarries and prospect holes were opened on the south and southwest slopes of the hill and at about the same horizon, which is 55 to 60 feet or more below the desert surface and a few hundred feet above the river.

I am indebted to Dr. Alexander Wetmore and C. W. Gilmore, of the National Museum, for encouragement in making this investigation and to the staff of preparators in the division of vertebrate paleontology for the excellent preparation and handling of the material. Acknowledgment also is made of the courtesy extended by the staff of the division of mammals of the National Museum in permitting access to the collections of recent horses. Dr. Walter Granger, Dr. Barnum Brown, and Dr. E. H. Colbert, at the American Museum of Natural History, graciously aided in allowing me to examine and measure mounted skeletons of *Plesippus simplicidens* and *Equus scotti*, and Dr. C. L. Camp and R. A. Stirton, of the University of California, kindly loaned me type material from the Pacific coast region. The drawings were made by Sydney Prentice.

#### PREVIOUS STUDIES IN SOUTHERN IDAHO

Paleontological investigations of Neocene and Quaternary deposits in the Snake River Basin have resulted in recognition of several horizons of vertebrate life. The earliest of these terrestrial series is the Payette formation, which apparently includes at least two faunal horizons, the older being middle or upper Miocene<sup>1</sup> and the later lower Pliocene.<sup>2</sup> The Idaho formation, with which we are here more concerned, is widely distributed over the western portion of the Snake River Basin and is not easily separated from the underlying Payette in areas where the two are in contact. The Idaho beds were

<sup>1</sup> Chaney, R. W., Amer. Journ. Sci., ser. 5, vol. 9, pp. 214-222, 1922; and Gazin, C. L., Carnegie Inst. Washington Publ. 418, pp. 37-86, 1932.

<sup>2</sup> Buwalda, J. P., Science, new ser., vol. 60, pp. 572-573, 1924.

named by Cope<sup>3</sup> on the basis of fish remains collected by Clarence King and others from exposures in the vicinity of Catherine and Castle Creeks and were believed to be Pliocene in age. The earliest reports on these fishes were made by Leidy<sup>4</sup> and Cope<sup>5</sup> in 1870. Deposits in the region generally referred to the Idaho formation probably comprise more than one horizon and apparently may be included within the limits of upper Pliocene and lower Pleistocene.

A collection of mammalian remains obtained by Clarence King from Idaho beds exposed along Sinker Creek, a short distance to the west of Castle Creek, included material identified by Leidy<sup>6</sup> as representing *Equus excelsus* and *Mastodon mirificus*. Collections made by N. F. Drake and others for Lindgren<sup>7</sup> were obtained at various localities, some of which may have come from deposits other than the Idaho formation. Among these materials F. A. Lucas identified *Mastodon*, *Castor*, *Equus*, *Rhinoceros*, *Procamelus*, *Cervus*, and an antelope. An equid type in the collection was believed by Marsh to represent *Protohippus*. A collection made by Russell<sup>8</sup> included a camel, an edentate, and fish remains, which Lucas considered to be of Pliocene age.

Later, in 1917, Merriam<sup>9</sup> discussed the relationship of the Idaho vertebrate fauna to other Pliocene assemblages, and in 1918<sup>10</sup> he described three new species from these beds, *Ischyrosmilus idahoensis*, *Neotragoceras lindgreni*, and *Equus idahoensis*. In 1927, O. P. Hay<sup>11</sup> cited all the forms then known to occur in the Idaho formation and possibly older beds together with those that came from later river gravels, and the whole was considered of Pleistocene age, primarily on the basis of materials coming exclusively from the stream gravels of undoubted Quaternary age.

#### OCCURRENCE AND PRESERVATION OF MATERIAL

The great bulk of quarry material occurred in a lens of reddish, bog-iron stained sand. Isolated bones and articulated skeletal portions were found scattered through the lens but were most concentrated near the bottom, lying near or on a more indurated limy layer, which in places varies to a thin gravel zone. The lens is irregular in outline but decidedly concave upward in the north-south profile, resembling a channel fill. The bog-iron staining suggests boggy conditions during accumulation of the bones, but this may have been produced subsequently by migrating waters, as even at present this channel above

<sup>3</sup> Cope, E. D., Proc. Acad. Nat. Sci. Philadelphia, vol. 35, pp. 134-166, 1883.

<sup>4</sup> Leidy, Joseph, Proc. Acad. Nat. Sci. Philadelphia, vol. 22, pp. 70-71, 1870.

<sup>5</sup> Cope, E. D., Proc. Amer. Philos. Soc., vol. 11, pp. 538-547, 1870.

<sup>6</sup> Leidy, Joseph, Proc. Acad. Nat. Sci. Philadelphia, vol. 22, p. 67, 1870.

<sup>7</sup> Lindgren, Waldemar, 20th Ann. Rept. U. S. Geol. Surv., pt. 3, p. 99, 1900.

<sup>8</sup> Russell, I. C., U. S. Geol. Surv. Bull. 199, p. 56, 1902.

<sup>9</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 10, pp. 431-434, 1917.

<sup>10</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 10, pp. 523-530, 1918.

<sup>11</sup> Hay, O. P., Carnegie Inst. Washington Publ. 322B, pp. 261-269, 1927.



the more impervious clays collects and yields water during the moist seasons. It appears unlikely that the animals were transported by water any distance after death but accumulated naturally around a water hole, aided possibly by bog trapping. There is no certain evidence of trapping, as in many places the depth of the fossiliferous lens between the underlying clay and the stratified, undisturbed overlying sand is hardly sufficient. Erosion, however, may have removed a portion of the zone, although this is not evident. At the periphery of the lens the bones extend into the unstained or less colored sand but in a more restricted zone, and in places on the south slope of the hill occur in a concretionary layer with a considerable portion of the material firmly cemented in large blocks of gray to white limy sand.

The bone material occurring in the more pervious red sand has to a large extent been affected by plastic distortion in which the bones, particularly in many of the skulls, have been warped and bent. Material, however, obtained in the hard concretionary patches is less distorted but prepared only with considerable time and labor.

The material collected in and about the principal quarry during the four seasons of work includes over 130 skulls and a large quantity of other skeletal material, some of which was discovered in a position of articulation. About a quarter to a third of the skulls include lower jaws, and 8 or 10 specimens are comprised of the greater part of the skeleton.

#### ASSOCIATED FAUNA AND ENVIRONMENT

Contemporary with *Plesippus shoshonensis* in the Hagerman lake beds was a large fauna including fishes, amphibians, reptiles, and a variety of birds and mammals. Remains of these animals were found at various localities within a distance of about 9 miles to the south of the quarry, a number being also represented in the quarry intermingled with the horse bones. The following is a list of the vertebrate forms known to occur in the Hagerman lake beds:

## FOSSIL VERTEBRATES FOUND AT HAGERMAN, IDAHO

## PISCES:

Various forms, principally cyprinid.

## AMPHIBIA:

Remains of frogs.

## REPTILIA:

Testudinata:

*Pseudemys idahoensis* Gilmore.

Serpentes:

*Thamnophis* sp.

## AVES:

Colymbiformes:

*Colymbus* sp.

Colymbid sp.

Pelecaniformes:

*Pelecanus halieus* Wetmore.

*Phalacrocorax idahensis* (Marsh).

*Phalacrocorax auritus* (Lesson).

*Phalacrocorax* sp.

Anseriformes:

*Cygnus* sp. a.

*Cygnus* sp. b.

*Chen pressa* Wetmore.

*Querquedula* sp.

Anatid sp.

Gruiformes:

Gruid sp.

*Gallinula chloropus* (Linnaeus).

Rallid sp.

## MAMMALIA:

Edentata:

*Megalonyx leptonyx*? (Marsh).

Insectivora:

*Blarina gidleyi* Gazin.

Carnivora:

Canid sp.

*Hyaenognathus* or *Borophagus* sp.

*Lutravus*? *idahoensis* Gazin.

*Lutravus*? *cookii* Gazin.

*Lutra* (*Satherium*) *piscinaria* Leidy.

*Felis lacustris* Gazin.

*Machairodus*? *hesperus* Gazin.

Proboscidea:

Mastodont sp.

Perissodactyla:

*Plesippus shoshonensis* Gidley.

Artiodactyla:

*Platygonus*, n. sp.

Camelid, possibly *Camelops arena-*  
*rum* Hay.

Camelid, possibly *Procamelus* or  
*Tanupolama*.

Cervid sp.

*Ceratomeryx prenticei* Gazin.

Lagomorpha:

*Hypolagus* near *vetus* (L. Kellogg).

*Hypolagus limnetus* Gazin.

*Alilepus*? *vagus* Gazin.

Rodentia:

Citellid sp.

Marmot sp.

*Thomomys gidleyi* Wilson.

*Castor accessor*? Hay.

*Ondatra idahoensis minor* Wilson.

*Mimomys primus* (Wilson).

Perhaps the most noticeable feature of the foregoing list is the number of aquatic types represented. This character of the fauna is even more evident in the frequency in which bones of these types are encountered compared to those representing forms having a less aquatic habit. The fish and frog remains are of common occurrence. The birds, though rare, are all of aquatic habit, according to Dr. Wetmore. Except horse, which is abundantly represented only at the quarry, and possibly peccary, by far the most numerous mammalian remains are of water-loving types, as beaver, muskrat, otter, and otter-like mustelids. Such an assemblage suggests a well-watered area with lakes or streams and possibly swampy sections. Carbonaceous zones are not uncommon in the sedimentary series as exposed, but consider-

able portions of the formation are noticeably gypsiferous, indicating periods of desiccation.

#### EVIDENCE AS TO AGE OF BEDS

The Idaho formation was early believed by Cope to be Pliocene on the basis of the fish remains that he described from these beds, and subsequent small collections of land vertebrates from various localities for the most part probably within the Idaho formation were considered as Pliocene by Leidy, Lucas, and Marsh. Merriam,<sup>12</sup> in 1917, reviewed the vertebrate evidence for the Pliocene age of various deposits in the Pacific coast and Great Basin regions and concluded for the Idaho beds that they were late Pliocene verging on Pleistocene. More recently Hay<sup>13</sup> expressed the opinion that the Idaho beds were Nebraskan in age. His reasons for considering them Pleistocene were unfortunately based primarily on materials coming from the river gravels in the eastern portion of the Snake River Basin, which are apparently no part of the Idaho formation.

The Hagerman lake beds, which may be considered a part of the Idaho formation, have produced a fauna that is probably an associated assemblage. Whether these forms were contemporaneous with those described from localities farther west believed to be within the Idaho formation there may be some doubt. It is my opinion that if these faunas are of different age the Hagerman assemblage may be slightly older than those at Bruneau River, Castle Butte near Grand View, Sinker Creek, and scattered occurrences in the Nampa-Caldwell region not coming from the Payette or Ironsides horizons. This opinion is based on the difference between certain of the Mammalia occurring at Hagerman and similar forms found elsewhere in the formation. Moreover, the fish assemblage seems not to include several of the large types abundantly represented in the more typical Idaho beds.

The Mammalia found at Hagerman appear to be in an advanced Pliocene stage both in development of several of the forms represented and in the composition of the fauna. Most noticeable is the absence of forms typically Pleistocene in age, as mylodont sloths, mammoths, *Mastodon americanus*, true *Equus*, bison, musk-ox, *Ursus*, *Castoroides*, and *Lepus*. Most of these are recognized in early or lower Pleistocene, possibly Aftonian, as indicated by Calvin's<sup>14</sup> work, or Yarmouth

<sup>12</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 10, no. 22, pp. 421-443, 1917.

<sup>13</sup> Hay, O. P., Carnegie Inst. Washington Publ. no. 322B, p. 269, 1927.

<sup>14</sup> Calvin, Samuel, Bull. Geol. Soc. Amer., vol. 20, pp. 341-356, pls. 16-27, 1909; vol. 22, pp. 207-216, pls. 18-24, 1911.

according to Lugn and Schultz.<sup>15</sup> Moreover, several of the forms present as *Hyaenognathus* or *Borophagus*, *Lutcravus*?, *Plesippus*, mastodont, *Mimomys*, and the rabbits show Pliocene affinities, many of the remaining genera as recognized being less restricted in time. The presence of a true cervid is not necessarily indicative of Quaternary age, as fragmentary remains have also been reported from the upper Etchegoin and Eden beds in California. *Megalonyx*, though well known in the Pleistocene, has been found in several Pliocene deposits.

On the basis of the vertebrate remains the Hagerman horizon appears not far removed from the Blanco stage in Texas. The differences between the faunas from two localities may be only of geographic significance. The Blanco shows a greater wealth of Proboscidea but fewer members of the microfauna. A comparative list of the known Mammalia in the two faunas is given on the next page.

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<sup>15</sup> Lugn, A. L., and Schultz, C. B., Nebraska State Mus. Bull. 41, vol. 1, pp. 319-393, 1934.

<i>Hagerman</i>	<i>Blanco*</i>
EDENTATA:	
<i>Megalonyx leptonyx?</i> (Marsh).	<i>Megalonyx leptostomus</i> Cope.
	<i>Myiodon</i> sp. (probably <i>Megalonyx</i> ).
	<i>Glyptotherium texanum</i> Osborn.
CARNIVORA:	
Canid sp.	
<i>Hyænognathus</i> or <i>Borophagus</i> sp.	<i>Borophagus diversidens</i> Cope.
	<i>Amphicyon</i> sp. (probably <i>Borophagus</i> ).
<i>Lutravus?</i> <i>idahoensis</i> Gazin.	<i>Canimartes cumminsi</i> Cope.
<i>Lutravus?</i> <i>cookii</i> Gazin.	
<i>Lutra</i> ( <i>Satherium</i> ) <i>piscinaria</i> Leidy.	
<i>Felis lacustris</i> Gazin.	<i>Felis hillanus</i> Cope.
<i>Machairodus?</i> <i>hesperus</i> Gazin.	
PROBOSCIDEA:	
Mastodont.	<i>Serridentinus praecursor</i> (Cope).
	<i>Rhynchotherium falconeri</i> Osborn.
	<i>Cordillerion tropicus</i> (Cope).
	<i>Stegomastodon successor</i> (Cope).
PERISSODACTYLA.	
<i>Plesippus shoshonensis</i> Gidley.	<i>Plesippus simplicidens</i> (Cope).
	? <i>Plesippus cumminsi</i> (Cope).
	<i>Nannippus phlegon</i> (Hay).
	<i>Neohipparion</i> sp. (probably <i>Nannippus</i> ).
ARTIODACTYLA:	
<i>Platygonus</i> , n. sp.	<i>Platygonus bicalcaratus</i> Cope.
	<i>Platygonus texanus</i> Gidley.
Camelid, possibly <i>Camelops arenarum</i> Hay.	<i>Pliauchenia spatula</i> Cope.
Camelid, possibly <i>Procamelus</i> or <i>Tanupolama</i> .	
Cervid sp.	
<i>Ceratomeryx prenticei</i> Gazin.	
LAGOMORPHA:	
<i>Hypolagus</i> near <i>vetus</i> (L. Kellogg).	
<i>Hypolagus limnetus</i> Gazin.	
<i>Alilepus?</i> <i>vagus</i> Gazin.	
RODENTIA:	
Citellid sp.	
Marmot sp.	
<i>Thomomys gidleyi</i> Wilson.	
<i>Castor accessor?</i> Hay.	
<i>Ondatra idahoensis minor</i> Wilson.	
<i>Mimomys primus</i> (Wilson).	

\* The Blanco faunal list is essentially as given by Gidley in 1903, with the notations by me, and the mastodont assemblage is as listed in a page proof of Professor Osborn's forthcoming monograph on the Proboscidea.

#### REVIEW OF LITERATURE ON PLESIPPUS

The genus *Plesippus* was proposed by Matthew<sup>16</sup> to include the species *Pliohippus simplicidens* (Cope)<sup>17</sup> from the Blanco formation

<sup>16</sup> Matthew, W. D., Amer. Mus. Nov., no. 131, pp. 1-2, 1924. See also Quart. Rev. Biol., vol. 1, no. 2, pp. 162-164, 1926.

<sup>17</sup> Cope, E. D., Proc. Amer. Philos. Soc., vol. 30, pp. 124-125, 1892.

of Texas and *Pliohippus proversus* Merriam<sup>18</sup> from the upper Etchegoin in the Coalinga region of California. *P. simplicidens* was originally described as a species of *Equus* but later referred by Gidley<sup>19</sup> to *Pliohippus*. The intermediate character of the teeth in these forms between *Pliohippus* and *Equus* as noted by Merriam and additional characters exhibited in the skeletons collected by Matthew and Simpson in the Blanco beds formed the basis for the genus *Plesippus*. A third species, *Equus cummingsii* Cope,<sup>20</sup> also from the Blanco, was later included by Matthew and Stirton<sup>21</sup> in *Plesippus*. This species was early referred to *Protohippus* by Gidley<sup>22</sup> and then to *Pliohippus* by Merriam<sup>23</sup> and by Osborn.<sup>24</sup> In 1930, Gidley<sup>25</sup> described the equid material from Hagerman to which he gave the name *Plesippus shoshonensis*. Subsequent finds of equid material that have been referred to *Plesippus* include teeth identified by Vander Hoof<sup>26</sup> as *Plesippus proversus* from the Tehama beds in California.

Mammalian material described by Frick<sup>27</sup> in 1921 from the San Timoteo Hills near the San Jacinto Mountains in southern California included equid specimens referred to *Pliohippus*, which may well represent *Plesippus*. Material designated as *Pliohippus francescana* and perhaps that named *Pliohippus osborni* appear from the illustrations to represent a stage of development comparable to that in material elsewhere referred to *Plesippus*.

#### CHARACTERS OF THE GENUS PLESIPPUS

The characters outlined by Matthew as defining the genus *Plesippus* are for the most part intermediate between those of *Pliohippus* and of *Equus*. With the accumulation of additional evidence showing the continuity from one genus to another, recognition of the limits of these genera necessarily becomes more arbitrary and perhaps questionable. The following diagnosis of *Plesippus* is taken from Matthew's<sup>28</sup> description of the Blanco material that he referred to *Plesippus simplicidens*:

<sup>18</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 9, no. 18, pp. 525-534, 1916.

<sup>19</sup> Gidley, J. W., Bull. Amer. Mus. Nat. Hist., vol. 14, art. 9, pp. 123-125, 1901.

<sup>20</sup> Cope, E. D., 4th Ann. Rept., Geol. Surv. Texas, 1892, p. 67, 1893.

<sup>21</sup> Matthew, W. D., and Stirton, R. A., Univ. California Publ. Bull. Dept. Geol. Sci., vol. 19, no. 17, pp. 359, 367 (tables), 1930.

<sup>22</sup> Gidley, J. W., Bull. Amer. Mus. Nat. Hist., vol. 14, art. 9, pp. 126-127, 1901.

<sup>23</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 9, no. 18, pp. 526-527, 1916.

<sup>24</sup> Osborn, H. F., Mem. Amer. Mus. Nat. Hist., new ser., vol. 2, pt. 1, pp. 168-169, 1918.

<sup>25</sup> Gidley, J. W., Journ. Mamm., vol. 11, no. 3, pp. 300-303, 1930.

<sup>26</sup> Russell, R. D., and Vander Hoof, V. L., Univ. California Publ. Bull. Dept. Geol. Sci., vol. 20, no. 2, pp. 17-21, figs. 4-6, 1931.

<sup>27</sup> Frick, Childs, Univ. California Publ. Bull. Dept. Geol., vol. 12, no. 5, pp. 277-424, 1921.

<sup>28</sup> Matthew, W. D., Amer. Mus. Nov., no. 131, p. 2, 1924.

This form is of the size and limb-proportions of the average Pleistocene species of *Equus*, much larger and more robust than true *Pliohippus*. The teeth are most like *Pliohippus*, but longer crowned and less curved, with heavier mesostyle and larger more nearly isolated protocone. The cement lakes of the upper molars are narrower, and their enamel borders have a few simple inflections. The skull has the elongate proportions of *Equus*, in contrast to the shorter skull of typical *Pliohippus* and earlier equids. It retains in the forefoot tiny vestigial nodules representing the trapezium and fifth digit, progressively reduced in the earlier stages of Equidae, normally absent in modern *Equus*. The splints are from two-thirds to three-quarters of the length of the cannon bone, nearly or quite as much reduced as in *Equus*, while in true *Pliohippus* the splints are almost as long as the cannon bone, and it is not certain that the lateral phalanges had entirely disappeared.

After further study of the Blanco material Matthew<sup>29</sup> observed that "the animal compares in size and most proportions with the Arab horse, but the hoofs are much smaller, the back shorter, and the barrel less rounded and convex." He also noted that the lateral digits or splints end "in a thin flattened and expanded sliver instead of the little knob of *Equus*", and that "the fibula is reduced to a splint which in *Plesippus* is distinctly shorter than in any species of *Equus*." Moreover, the skull was observed to have shallow facial pockets or fossae, more reduced than in *Pliohippus*.

A number of outstanding characters are noted in the Hagerman material, many of which were observed by Gidley in the more limited collection he had at his disposal, and most of these are probably of generic significance. The cranium is short and markedly deflected from the distinctly elongate facial portion. The preorbital fossa anterior to the lachrymal bone is conspicuously developed along the line of the suture between the nasal and maxilla. The rostrum is deep anteriorly and narrow across the nasals. The first premolar above is well developed and almost always present. The first premolar below is simple and commonly present in young individuals. The cheek teeth approach in appearance those in *Equus*, somewhat more so in the earlier stages of wear. The feet are comparatively small, and the splint bones are reduced but with their average length relatively greater than in *Equus*. A few trapezia were found, but very nearly all the trapezoids show well-marked facets as evidence for articulation with a trapezium. A single fifth metacarpal was discovered. These apparently left little or no impression on the fourth metacarpal or outer splint as evidence of their possibly more general occurrence.

#### PLESIPPUS SHOSHONENSIS Gidley

*Specific characters.*—The characters of the species, though not clearly separated from those defining the genus, may be briefly outlined as follows: The skull is large and the relatively short cranium exhibits a narrow, sharply overhanging occipital crest. The teeth

<sup>29</sup> Matthew, W. D., Quart. Rev. Biol., vol. 1, no. 2, pp. 162-164, 1926.

are large with a moderately simple pattern. The robust incisors are noticeably erect and  $P^1$  is well developed. The dorsal and lumbar vertebrae are relatively elongate with narrow centra. The zygophyses are comparatively close together, and the metapophyses usually project forward noticeably. The limb bones are moderately slender and the feet distinctly small and narrow. Greater detail will be found in the comparative study of the skeleton. Many of the characters there observed may be of specific importance, but comparisons were somewhat handicapped by the limited quantity of recent skeletal material available, other than skulls and jaws.

*Comparisons with other species.*—Of the comparisons which may be made with various species of fossil horses perhaps the most pertinent concerns *Equus idahoensis*. The species was described by Dr. J. C. Merriam<sup>30</sup> from a few teeth obtained by the University of California in beds believed to belong to the Idaho formation. The type, a much-worn isolated premolar, was found at a locality near Fromans Ferry, about 8 miles southwest of Caldwell, Idaho. Referred to this species were also an isolated lower premolar from Fromans Ferry and a little worn upper tooth, presumably  $M^1$ , from a locality about  $4\frac{1}{2}$  miles southeast of Payette, Idaho. Comparisons with this species were made by Dr. Gidley and accompanied his description of *P. shoshonensis*, but it seems desirable here to recapitulate and add further observations apparent upon examination of a large number of Hagerman dentitions.

The anteroposterior length of the type tooth of *Equus idahoensis* is equaled or exceeded in only two Hagerman specimens, and the area of the occlusal surface is greater than in any tooth, including those of the largest individuals in an early adult stage. When comparison is made with teeth in a comparable stage of wear the difference in size is more noticeable. The development of the protocone anterior to the isthmus is more progressive than in our form at this stage of wear, and the constriction of the isthmus as well as the transverse development of the protocone is noticeably greater. In the Hagerman specimens the reentrant forming the anterior wall of the protocone becomes much reduced in advanced wear, resulting in a broad union between protocone and protoconule.

The anteroposterior length of the lower premolar from Fromans Ferry is equaled or exceeded in three of our specimens, but the width and crown area are greater than in any of the Hagerman material. However, the enamel pattern of this tooth is not so *Equus*-like as in lower teeth of *Equus pacificus* from the Fossil Lake region of central Oregon.

The upper tooth from near Payette, referred to *E. idahoensis*, appears less curved and is more hypsodont than in our material where

<sup>30</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 10, pp. 527-530, 1918.



these characters can be observed. In Hagerman specimens of equal vertical length the pattern shows them to be less worn, as the enamel lakes are not then isolated as they are in the Payette tooth. Moreover, the lakes in the latter specimen are more constricted with the margins somewhat more elaborately crenulated than is usual in *P. shoshonensis*.

The foregoing observations would appear unimportant were it not for the large number of dentitions available for comparisons, which give reasonable definition to the variability of *P. shoshonensis*. The greater size of *Equus idahoensis* occurring at more western localities in the Idaho beds is further suggested by foot material obtained in 1934 from deposits exposed along Sinker Creek. However, a last upper molar (U.S.N.M. no. 687), collected by Clarence King on Sinker Creek and considered by Leidy to represent *Equus excelsus*, can be closely matched in the Hagerman collection.

The genotype, *Plesippus simplicidens* (Cope), is based on a single upper cheek tooth and referred lower teeth from the Blanco beds of Texas but more adequately represented by skeletal material in the American Museum of Natural History collected by Matthew and Simpson. This material formed the basis of Matthew's<sup>31</sup> description of *Plesippus*.

The skull of *Plesippus simplicidens* (Amer. Mus. no. 20077) is within the size range exhibited by skulls of *P. shoshonensis*. The cranium is relatively a little longer and the facial length appears relatively less, even though the premaxillae are restored with a greater diastema between I<sup>3</sup> and P<sup>2</sup>. The lachrymal fossa is noticeably developed, as in Idaho specimens where this character is not obscured by crushing; moreover, a very shallow malar fossa is present. The nasals are slightly concave longitudinally and narrow transversely over the lachrymal fossae and are also infolded along the median line. The supraoccipital is narrow and somewhat overhanging though not so conspicuously so as in the Idaho form. The basicranial line is deflected from the basifacial line to a marked degree as in *P. shoshonensis*, but the angulation is not so acute at the contact of the basisphenoid and vomer, the longitudinal profile of the ventral margin of the basioccipital and basisphenoid being more concave. The ventral surface of the basioccipital and basisphenoid is rounded transversely and is slightly rough but not keeled as observed in some *Equus caballus* skulls from individuals of equally advanced age. The external audital tube, as in *P. shoshonensis*, is directed upward and backward to a marked degree. Also, as in the Idaho skulls, the distance from the palate to the posterior margin of the vomer is distinctly greater than the distance from the vomer to the foramen magnum.

<sup>31</sup> Matthew, W. D., Amer. Mus. Nov., no. 131, p. 2, 1924.

The cheek teeth in the skull of *Plesippus simplicidens* are badly checked and in an advanced stage of wear, with the fossettes in  $M^1$  nearly obliterated. In all the cheek teeth the fossettes through wear are much constricted and the protocone broadly united with the protoconule. The occurrence of  $P^1$  is indicated by a small alveolus.

The dorsal and lumbar vertebrae appear slightly shorter and perhaps less slender than in *P. shoshonensis*. Measurements given for the articulated series of vertebrae of *P. simplicidens* in table 3 are relatively great on account of spacing of the vertebrae in the mounted skeleton. The bones of the fore limb relative to those of the hind limb are larger than in articulated skeletons of *Plesippus shoshonensis*. The proportions of the hind limb of *P. simplicidens* compare favorably with those of the hind limb of an average-sized individual of *P. shoshonensis*, although the third metatarsal appears short and relatively less slender than in the Idaho material. The scapula of the Texas form shows a broad area with a double ridge between the glenoid surface and the tuber scapulae, as in the Idaho form, and a similarly proportioned glenoid surface. Also, as in *P. shoshonensis*, the ridge between the bicipital grooves on the proximal end of the humerus is less outstanding than the inner and outer ridges.

The essential differences between *Plesippus shoshonensis* and *P. simplicidens* lie in the somewhat longer facial and shorter cranial portions in the skull of *P. shoshonensis*, with a sharper angle between the vomer and basisphenoid, and in a more elongate back and smaller fore limbs. The two occur at localities widely separated geographically; however, there is little to suggest any significant interval of time between the two forms.

*Plesippus proversus* (Merriam)<sup>32</sup> from the upper Etchegoin in the Coalinga region of California was originally described as a species of *Pliohippus*, but recognized by Dr. Merriam as an intermediate stage between *Pliohippus* and *Equus*. The type (Univ. Calif. no. 21330) is an isolated upper cheek tooth, presumably  $M^2$ , and referred specimens from the same locality include portions of several upper and lower cheek teeth, and incomplete foot remains.

The material representing this species does not justify extensive comparisons, although a few characters appear significant in recognizing the position of this species and in distinguishing between it and *P. shoshonensis*. The teeth are of good size and show moderate curvature. The pattern is essentially simple, perhaps more so than is common in *P. shoshonensis*. The protocone is elongate in the type with very little of it projecting anterior to the isthmus leading to the protoconule. The outline of the protocone is more nearly a smooth oval than is common in the Idaho teeth. In the foot material the

<sup>32</sup> Merriam, J. C., Univ. California Publ. Bull. Dept. Geol., vol. 9, no. 18, pp. 525-534, 1916.

distal end of a metapodial is relatively narrow and deep as compared with the Idaho material, and a first and second phalanx in the collection are distinctly small, even for a hind foot. The first phalanx is incomplete, but enough of it remains to show that it was much shorter than in *P. shoshonensis*.

*P. proversus* appears to be a somewhat earlier stage of *Plesippus* than found at Hagerman although this cannot be certainly demonstrated without far more adequate material from the upper Etchegoin. The material from the Tehama beds, referred by Vander Hoof<sup>33</sup> with proper conservatism to *P. proversus*, exhibits a slightly more complex pattern, but here again the Coalinga material does not justify detailed comparisons.

#### COMPARATIVE STUDY OF THE SKELETON OF PLESIPPUS SHOSHONENSIS

In the study and description of the skeletal structure of *Plesippus shoshonensis* comparison is made primarily with the large zebra *Equus (Dolichohippus) grevyi*. A large series of skulls of this species are available in the National Museum collections, and being of a wild species they do not show the effects of domestication and selective breeding so apparent in a series of *Equus caballus* skulls. Moreover, the fossil species compares favorably in size of skull and limb proportions with *E. grevyi*. The general skeletal material of *E. grevyi* in the collection is, however, much more limited, and for this reason detailed comparisons of vertebrae and limbs between fossil horse and the recent zebra are not entirely satisfactory. The *E. caballus* vertebrae and limb material are also scant.

*Skull.*—The skull of *Plesippus shoshonensis* is elongate, with the cranium relatively shorter than in *E. grevyi*. Perhaps the most distinctive character of the fossil skulls is the greater angle between the basicranial and basifacial axes than in modern species (pl. 24, fig. 2; pl. 25, fig. 1; pl. 26, fig. 2). The degree of cytocephaly or bending of the face on the cranium combined with the relative shortness of the latter has given the basicranial area a noticeably different appearance. The vomerine index is greater or the distance from the palate to the posterior notch in the vomer is relatively much greater with respect to the distance between the vomer and foramen magnum (pl. 25, figs. 2, 3) than in either *E. caballus* or *E. grevyi*.

The point of greatest deflection appears to be at the junction of the vomer and the fused basisphenoid and presphenoid bones, with the notch formed by the vomer and pterygoids more obtuse in the fossils. The basioccipital and basisphenoid are broad and generally rounded ventrally. In some old individuals of *E. caballus* the basioccipital is

<sup>33</sup> Russell, R. D., and Vander Hoof, V. L., Univ. California Publ. Bull. Dept. Geol. Sci., vol. 20, no. 2, pp. 17-21, figs. 4-6, 1931.

noticeably narrow and sharply constricted along the median line. The distance between the postglenoid and paroccipital processes is shorter, accompanied by a more posterior and upward direction of the external auditory tube, which passes through a higher and more acute notch in the squamosal (see pl. 25, fig. 1). Moreover, the periotic appears more crowded between the squamosal and exoccipital, and the opening of the postglenoid or temporal canal is more obscured than in *E. grevyi*. The bending of the cranium has also given the line of the occiput a greater backward tilt, and the occipital crest is much narrower and more sharply overhanging.

In the facial region the skull is characterized by a prominent fossa along the line of the naso-maxillary suture just anterior to the lachrymal bone. In some specimens, as in the type, there is also indication of a slight fossa near the anterior margin of the jugal. In longitudinal profile the skulls show a distinct dorsal concavity as in *E. grevyi*, which in the fossils is immediately above the prominent facial fossae. The width across the nasals at this point is less, but the depth of the rostrum anterior to the dorsal concavity appears greater than in *E. grevyi* and the width between the orbits appears greater. The naso-frontal suture deviates considerably from a straight line, somewhat as in *E. caballus*, much more than in *E. grevyi*, which exhibits an only slightly inflected nasofrontal suture. The premaxillo-maxillary portion anterior to the cheek teeth is elongate and relatively heavy as in *E. grevyi*, and the anterior extremity is deep with the incisors recurved as in that species, less procumbent than in individuals of *E. caballus* of comparable age. The palate is noticeably broad in specimens where this portion is not distorted by crushing, and in many of the skulls the palatal surface of the rostrum appears more sharply constricted immediately anterior to the cheek teeth (pl. 25, figs. 2, 3), although the body portion of the premaxillae is as heavy and wide or perhaps slightly wider than in Grevy's zebra. The nasal process of the premaxilla is deep posteriorly, more so than is common in *E. caballus*. The cheek teeth occupy a longer portion of the maxilla than in *E. grevyi*, and the posterior extent of the cheek teeth in some of the specimens is somewhat greater with respect to the orbit and glenoid fossa than in *E. grevyi* skulls in comparable stages. The distance between the incisors and cheek teeth varies appreciably but averages somewhat less than in *E. grevyi*. Also the surface of occlusion on the incisors appears on the average to be more nearly in line with the occlusion of the cheek teeth. In *Equus* the position of the occlusion of the incisors is generally somewhat lower.

Indices or ratios of various measurements of the skulls, while apparently significant in a series of recent skulls where accurate measurements can be made, can not be determined satisfactorily or even approximately in the Hagerman collection where based on

measurements taken in different directions. This is due to the warped condition of most specimens and to a certain degree of crushing in at least one direction. Simple measurements, while they may be satisfactory in one direction, are in most cases approximate or only estimated in a direction right angles to this.

*Superior dentition.*—The incisor teeth are large and broad with deep cups that persist with wear nearly as long as the enamel pattern on the cheek teeth. The enamel on labial surface of the incisors usually shows shallow grooves, and in the third incisor the enamel on the lingual surface is generally interrupted in unworn or slightly worn teeth in one or two places, about midsection and near the posterior margin of the cup. At the midpoint the enamel is sometimes infolded forming a ridge or spur extending down the inner wall of the cup. Occasionally this spur is seen in the second incisor, as in no. 12543.  $I^3$  is further characterized by a prominent style along the posterior margin of the column.

The canine is present in nearly all adult individuals although much reduced in the females. In the males the tooth is large with the crown portion transversely compressed along the anterior and posterior margins. The compressed portions are curved inward so that the external surface of the tooth is evenly rounded and the lingual surface shows two marginal valleys.

The first premolar or "wolf tooth" is large and present in nearly every specimen, including some of the most aged individuals, as in no. 12530. This tooth perhaps should be considered as belonging to the deciduous series, as its eruption takes place with them although it is not replaced, and in the case of the fossil material persists along with the permanent teeth. In the unworn condition the tooth generally consists of a prominent central portion or cusp with a narrow ridge extending anteriorly toward a subdued cusp or style and posteriorly along the buccal side of the tooth to a conspicuous enlargement or cusp. In the larger of the teeth there is also generally a small cuspule postero-internal to the central cusp and antero-internal to the posterior cusp, and in wear apparently unites first with the posterior cusp forming a deep reentrant extending postero-externally from the lingual surface (fig. 21, no. 12543). The pattern in many cases is complicated by other small reentrants and grooves around the posterior cusp and lingually between the anterior style and central cusp.

The principal cheek teeth are well cemented and of large size with the greatest width generally through the third premolar, occasionally the fourth premolar is equally wide. The external styles are outstanding but simple and in general noticeably compressed antero-posteriorly, especially in the molar series. This is particularly true of the mesostyles in most dentitions, except in  $P^3$  where this style may

show one or two antero-external grooves (fig. 21, no. 12541). In specimens where the styles are somewhat constricted inwardly the flattened lateral surface of the style is faced sharply forward. The concavity between the styles in many specimens is more acute in the first two molars than in the premolars as in no. 12546 (fig. 21).

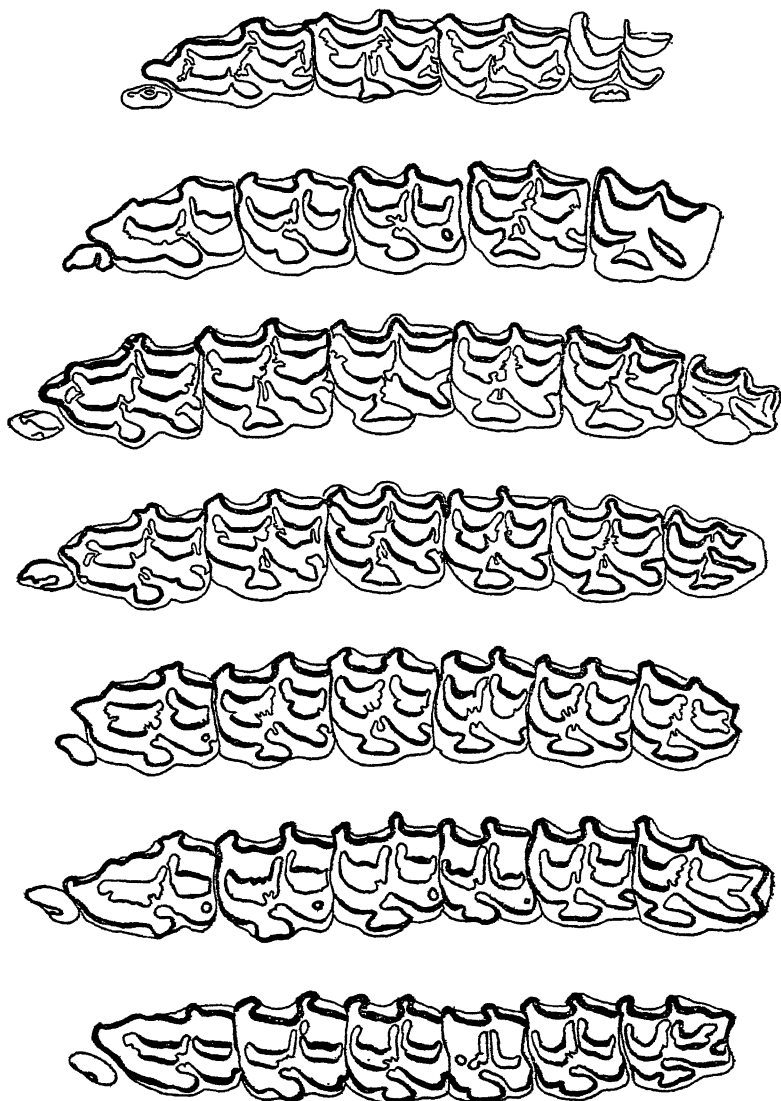


FIGURE 21.—*Pleistippus shoshonensis* Gidley. Enamel patterns of left upper cheek teeth in seven selected individuals arranged according to age. In the first two dentitions the premolars belong to the deciduous set. U.S.N.M. nos. (from top to bottom) 12494, 12520, 12541, 12543, 12576, 12546, and 12548. One-half natural size. Hagerman lake beds, upper Pliocene, Idaho.

The fossettes are relatively large and usually simple. The plications on the metaloph between the fossettes are commonly small and numerous in very early stages of wear, but markedly reduced or obliterated in moderate wear. A slight pli prefossette may persist in some specimens in advanced wear. Moreover, a single or double pli prefossette may persist longer in  $P^3$  than in other teeth. The posterior fossette plications on the metaloph in some instances are fewer and somewhat larger. A single or double pli postfossette may persist longer than the pli prefossette, though usually an early reduction takes place as on the anterior wall of the metaloph. The pli protoloph and pli protoconule in the anterior fossette are noticeably developed in early wear. The pli protoloph is early reduced in the molars but in the premolars is very persistent and may be double or triple as in no. 11989. In  $P^2$  the protoloph unites with the anterior style of this tooth in two places isolating a small lake (fig. 21, no. 12543), which may persist until the tooth is moderately well worn. The pli protoconule though not heavy is apparently the most persistent plication in the anterior fossettes and can be seen in teeth of advanced wear. It is difficult to determine whether this plication arises from the crochet or protoconule, certainly very near the junction of the two. It may be single or double, and in a few teeth it is found to be triple (fig. 21, no. 12576). The pli hypostyle is not well developed in most of the specimens and like the pli protoloph is much reduced in the molars except in some specimens in early wear where the premolars are in the stage of eruption. In  $M^3$  a prominent plication may arise from the posterior wall of the postfossette (fig. 21, no. 12576 and no. 12546), but this region of  $M^3$  is very irregular and occasionally the posterior fossette is open in advanced stages. The pli caballin extending into the postprotoconal valley is best developed in  $P^3$  and  $P^4$  and may be long and slender in early stages of wear but reduced to a greater extent than the pli protoconule with moderate wear. In many dentitions the pli caballin is only feebly developed in the molars and perhaps early obliterated or reduced to a very slight plication, which may persist to advanced wear.

The appearance of the protocone varies considerably with wear and between teeth in the same dentition. In early wear the pattern is sharply triangular, uniting with the protoconule after the initial truncation of the column. The sides of the triangle are nearly straight at first, although in some teeth the lingual wall of the column shows a shallow groove nearly as in *Equus*, though generally more subdued. Unlike *Equus* this wall in many cases may be noticeably convex, as in specimen no. 12573. With moderate wear the postero-external wall exhibits a simple convexity. The antero-external wall in early stages of wear is generally straight and generally remains more nearly so in the premolars. In  $M^1$  and  $M^2$  the anterior extremity approaches in

moderate wear the "heel" seen in *Equus*. With progressive wear the angles of the protocone in all teeth become more rounded, the sides more convex or sinuous, and the isthmus of attachment widens with the shortening of the antero-external wall. In advanced wear (fig. 21, no. 12548) the protocone column generally becomes smaller and more rounded, and the enamel reentrant defining the anterior portion of the column is much reduced. At this stage the fossettes are simple and U-shaped, and the teeth more strongly resemble those in *Pliohippus*.

The anteroposterior length and transverse width of the protocone vary considerably between the teeth in the same dentition. The width is noticeably greater in  $P^3$  and  $P^4$  than in the molars, usually being relatively narrow in  $M^3$ . The length is shortest in  $P^2$  where the column is simple with little or no portion projecting anterior to the isthmus. The protocone increases in length posteriorly, although  $P^4$  in many dentitions shows a larger and more angular column than in  $M^1$ , on account of the disparity in stage of wear between the two teeth. In  $M^3$  the protocone reaches a length nearly half that of the occlusal surface of the crown, and the postero-external wall is usually more sinuous than in other teeth. The antero-external wall of this column in  $M^3$  is commonly short and straight throughout wear and projecting but very little anterior to the isthmus.

The hypocone is simple and tapers to nearly a point postero-internally in early wear but becomes blunt with moderate attrition. It is separated from the metaconule by a slight constriction and does not project lingually so far as does the protocone. In the premolars there is generally a spur projecting inward from the hypostyle forming a section of the posterior wall of the tooth. In well-advanced wear this spur may unite with the distal portion of the hypocone, thereby isolating a small enamel lake (fig. 21, no. 12546). This spur from the hypostyle is absent in the first two molars of nearly every dentition, and only rarely in very advanced wear was the hypocone observed to unite distally with the hypostyle, except through obliteration of the enamel reentrant between them. In  $M^3$ , however, the hypostyle commonly unites with the distal end of the hypocone rather than with the metaconule, except where the postfossette remains open. Union is frequently made later, in more advanced wear, with the metaconule also, leaving a lake as in some of the premolars. Occasionally in  $M^3$  the hypostyle unites first with the metaconule (fig. 21, no. 12548), in which case a closer resemblance is seen to other cheek teeth in the series.

*Superior deciduous dentition.*—The upper milk teeth are exhibited in 35 or more of the skulls in the collections. Stages are represented from that in which the teeth are erupting to the period where they are replaced by the permanent series. A large proportion of these skulls,



however, are at a stage in which the first true molar is just erupting. In the course of replacement  $Dp^2$  is lost at about the time  $M^2$  is in early wear and  $M^3$  is just erupting. The central incisors are replaced apparently a little earlier, at about the time  $M^2$  is commencing to wear.  $Dp^3$  and  $Dp^4$  are replaced in order, with  $P^4$  beginning to wear at about the same time or slightly ahead of  $M^3$ . The lateral milk incisors are somewhat slower to be replaced, with  $I^2$  erupting at about the time  $P^4$  and  $M^3$  begin to wear, at an age probably between 4 and 5 years, and  $I^3$  is the last to appear. The permanent canine comes in at about the time of  $I^2$  or  $I^3$  in the males, perhaps earlier in the females where this tooth is much smaller.

The deciduous incisors are a little larger than in *Equus grevyi*, particularly in their labio-lingual width. The crowns are brachydont, with shallow, occasionally cement-coated cups. The first incisors are generally the heaviest and the third the shortest crowned and weakest. The third incisor is also usually somewhat constricted transversely near the posterior end.

The milk canine was not observed in any of the specimens, although most of the immature skulls show either an alveolus or a roughened area at this point. In a few instances the size of the alveolus suggests a tooth larger than in the modern horses observed.

The three deciduous premolars (fig. 21, no. 12494 and no. 12520) are of comparatively large size and with the anteroposterior length relatively great. The teeth are moderately hypsodont but much less so than the permanent cheek teeth. Accompanying the greater relative length of the occlusal surface the fossettes are elongate and the proto-loph is noticeably wide anterior to the pre-fossette. The teeth are generally well cemented except in the fossettes where cementation is usually not complete, and in one instance (no. 13842) the dentine was not completely developed in the cusp area. The meso-styles on the outer walls of  $Dp^3$  and  $Dp^4$  are compressed as in the permanent teeth, but the area between the styles is more flattened and the parastyles are relatively heavy though apparently not heavier than in *E. grevyi*. The fossettes are generally simple and show a plicate border highly variable as in the permanent teeth, with the pli protoconule usually the best developed. The fossettes also show a tendency to remain open. The anterior fossette in many dentitions remains open with appreciable wear through the postprotoconal valley, especially in  $Dp^2$ , with the pli protoconule projecting from the proto-loph and a highly variable pli caballin extending into the postprotoconal valley from the crochet. The posterior fossette in  $Dp^4$  is commonly open posteriorly external to the hypostyle (fig. 21, no. 12494), and in a few instances, as in no. 12484, the postfossette in  $Dp^2$  is open through the posthypoconal valley.

The protocone on  $Dp^2$  and  $Dp^3$  though large is usually simple and rounded, resembling this cusp in  $P^2$ . In  $Dp^4$  this cusp or column appears more advanced showing a more angular antero-internal extremity, a greater anteroposterior extent, and a flatter inner wall. With wear the protocone in each case becomes more nearly oval and broadly connected to the protoloph.

The hypocone is small in comparison with that in the permanent teeth, and the valley defining it posteriorly is somewhat irregular but reduced with wear much earlier than that posterior to the protocone. The hypostyle generally extends a strong plication lingually, and in one or two instances the valley or reentrant posterior to the hypocone is closed posteriorly, leaving, as in some of the permanent premolars, an isolated lake. More commonly such an isolated lake is formed in early wear near the anterior end of  $Dp^2$  similar to that in  $P^2$ .

*Mandible*.—The mandibles (pls. 27, 28) vary appreciably in size and shape, although certain features are observed that are distinctive or that show an average difference from mandibles of modern types. The portion of the jaw below the dentition is relatively deep and heavy in young adults, and the line of the occlusal surface of the cheek teeth is more convergent anteriorly with the general direction of the inferior margin of the ramus. The ventral margin shows a pronounced vascular impression anterior to the angle, which is perhaps not so sharply deflected at this point as in *E. grevyi* but anterior to this point, and centered approximately below  $P_4$  is a very marked ventral convexity, which in most cases is distinctly more prominent than in *E. grevyi* and much more so than in *E. caballus*. In young individuals the inferior margin of the ramus is more nearly straight (pl. 27, fig. 1, no. 12560). From the ventral convexity forward in adults the lower margin of the jaw rises more rapidly than in *E. grevyi* to the symphysial portion, which with the incisors is broader and generally higher with respect to the line of the cheek teeth. The distance between the incisors and the cheek teeth is great though averaging somewhat less than in *E. grevyi*. The portion of the fused mandibles between the incisors and premolars is constricted dorsally to about the extent in *E. grevyi*, but perhaps more abruptly so immediately behind the canines (pl. 28).

The ascending ramus is directed backward about as in *E. grevyi* with the posterior margin below the condyle nearly vertical (pl. 27, fig. 2, no. 12553) with respect to the ventral plane or table surface when resting normally. In *E. caballus* the anterior margin tends to be more nearly vertical, and the posterior margin rises upward and generally forward to the condyle. The anterior surface of the ascending ramus appears wider in the fossil jaws than in *E. grevyi* and the fossa on the upper portion of the outer surface of the ascending ramus appears better defined than in the recent zebra and horse.

*Inferior dentition.*—The lower incisors are large and broad, with the enamel on the labial surface thicker than that on the lingual surface and generally grooved or slightly irregular. The cup in the first two incisors is well toward the lingual surface and is less deeply impressed than in the upper incisors, as it is more rapidly reduced or obliterated, particularly in  $I_1$ . In unworn  $I_1$  and  $I_2$  the inner wall of the tooth is appreciably lower than the outer and generally uneven or cusped.  $I_3$  is broadly open on the lingual side and in most cases does not exhibit a lingual styler cusp, nor does the enamel form a cup, although in a few instances a small cup is present.

The lower canine, lying a short distance posterior to the third incisor, is very similar in the males to that in the upper jaw, though perhaps a little smaller. In the females the tooth is small, occasionally absent, but generally more erect than in *E. grevyi*.

$P_1$  is usually present in young specimens; associated with the milk dentition, to which series it may well belong. It is a small simple conical cusp, not unlike that seen in young specimens of *E. grevyi*. Unlike  $P^1$  this tooth is apparently lost with the eruption of the permanent premolars.

The lower cheek teeth (fig. 22) are large, robust, and heavily cemented, with little or no lateral curvature. The greatest width is generally across the third premolar or second tooth in the series. The pattern of the teeth though variable is rather simple and with few or no plications on the major reentrants on the lingual side of the teeth, except in early stages of wear. The two internal enamel reentrants of the premolars in early wear may show an irregular plicate condition, more noticeable in the posterior fold in which a slight plication opposite the ectostylid persists in some dentitions to advanced wear. These lingual loops are as extensive as in recent *Equus* dentitions but are generally less compressed transversely.

The parastylid is simple and of variable length and commonly shows a single flexure about midway along the posterior wall, except in  $P_2$  where the development characteristic of this tooth is seen. In a few instances in  $P_3$ , in dentitions where the parastylid is shortest, a slight style is seen extending outward from the antero-external angle of the tooth. In one case, no. 12533, this portion of the tooth appears as if the parastylid were reversed and directed externally.

The metaconid-metastylid columns are usually simple and rounded, with the metastylid possibly somewhat less angular than is usual in the *Equus* material observed. The groove between the columns is generally acute but on the average much shallower or less deeply impressed than in *E. grevyi* or *E. caballus*. In *E. caballus* this groove is usually more widely open.

The entoconid and adjoining hypoconulid are simple and rounded in moderate wear, with no significant features to distinguish them in the fossil form.

On the outer surface the external walls of the protoconid and hypoconid appear more convex in many of the specimens than in *E. grevyi* or *E. caballus*, although in some dentitions flattening is noticeable. The reentrant between the columns is shallow and acute in the premolars though deeper and more open in the molars. The

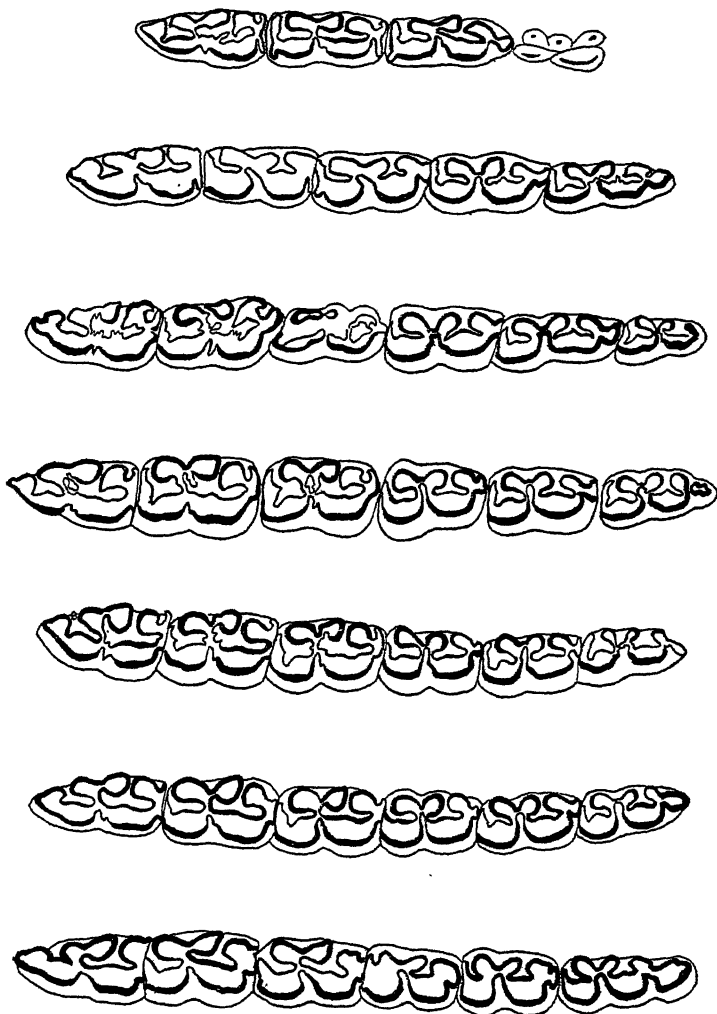


FIGURE 22.—*Plesippus shoshonensis* Gidley. Enamel patterns of left lower cheek teeth in seven selected individuals arranged according to age. In the first two dentitions the premolars are deciduous. U.S.N.M. nos. (from top to bottom) 12560, 12785, 12776, 12790, 12553, 12504, and 12546. One-half natural size. Hagerman lake beds, upper Pliocene, Idaho.

ectostylid is only slightly developed in the premolars except in early wear and in the molars is generally feeble or absent.

With advanced wear (fig. 22, no. 12504 and no. 12546) the walls of the outer columns become more convex, and the lingual reentrants are reduced in extent and are more compressed. The lingual walls of the inner columns are well rounded except for the metastylid, which may become more acute posteriorly. The anterior lingual fold shows the most marked reduction with the outer median fold most persistent. The anterior branch of the posterior lingual fold is also retained relatively late.

The differences between molars and premolars of the lower dentition are very noticeable, and in addition to the greater size of the premolars the two principal enamel loops from the inner wall are more deeply impressed and less transversely compressed than in the molars. In the posterior reentrant the anterior wing extends almost to the anterior loop and lingually nearly to the groove between the metaconid and metastylid, noticeably constricting the union between these columns. In the molars the reentrant from the outer surface between the protoconid and hypoconid extends nearly to the groove between the metaconid and metastylid, widely separating the contiguous portions of the anterior and posterior lingual folds. The hypoconulid is more shortened anteroposteriorly in the premolars. In the molars this cusp reaches its maximum development in  $M_3$  and is moderately well developed in slightly worn  $M_1$  and  $M_2$ .

*Inferior deciduous dentition.*—As is true of the young skulls, a relatively large number of the immature mandibles are in a stage of development in which the milk premolars are in moderately early wear with  $M_1$  just erupting, probably a little less than a year old, meeting death perhaps early in spring. The replacement of the lower milk teeth is in the same order as in the upper jaw.  $Di_1$  is first to go, followed by the milk premolars in order, and  $Di_2$  as  $M_3$  erupts.  $Di_3$  is replaced about the time  $P_4$  and  $M_3$  commence wear.

The lower milk incisors are simple, low crowned, and shallow cupped. The cup in  $Di_3$  is usually imperfectly formed or nearly absent, and in a few specimens there is a small cusp or a style in the middle or anterior portion of the embayment. In no specimen was a milk canine observed. A small opening at about the position of the canine might well be a foramen such as is seen in recent immature mandibles.

The well-cemented lower deciduous premolars (fig. 22, no. 12560 and no. 12785) though hypsodont are relatively short crowned compared to the permanent cheek teeth. The milk teeth are narrow and relatively elongate anteroposteriorly. The columns are transversely compressed and generally show simple or little-plicated

enamel walls. The reentrant between the outer columns is shortest in  $Dp_2$  and deepest in  $Dp_4$ , with an ectostylid usually best developed in  $Dp_2$ . In each dentition the metaconid increases in length antero-posteriorly in succeeding teeth and the metastylid decreases. The groove between these columns in most dentitions is shallow though somewhat acute. The two lingual reentrants are transversely compressed though of considerable anteroposterior extent. A marked feature of the milk premolars, more noticeable in the fossil material than in recent jaws, is the development of slender styles transversely along the anterior and posterior walls of the teeth (fig. 22, no. 12560), except in relatively little worn dentitions. The parastylid and an antero-external style usually extend the width of the tooth in the fossil  $Dp_3$  and  $Dp_4$ , and the hypoconulid combined with a hypostylid extends an enamel surface across the posterior wall of  $Dp_2$  and  $Dp_3$ . The parastylid of  $Dp_2$  and the hypoconulid of  $Dp_4$  are normally extended fore and aft.

*Hyoid*.—Parts of the hyoid have been found associated with the skull in several cases, and in a few the assembly is well preserved and nearly complete (pl. 29). The stylohyal is about the length of that in *E. grevyi*, as represented in two specimens, but is deeper and more robust, particularly through the middle section. This element is similar to that in *E. caballus* but less variable in size, and the muscular or posteroventral angle is well rounded though less attenuated than in the few recent specimens observed. Also the process that connects with the tympanohyal is less drawn out.

The epihyals were not found in any of the specimens, and the ceratohyals are not very well preserved, but these appear proportioned about as in the Arabian horse, not so heavy as in some of the larger domestic forms. The basihyal is moderately robust with a prominent lingual or glossohyal process which shows a more marked concavity or groove along each side than in any recent material examined. A single basihyal of *E. grevyi* shows a much shortened lingual process. The thyrohyal is variable in length and shows a prominent groove along the ventromedial surface extending from the basihyal well toward the posterior extremity. This portion of the thyrohyal examined in *Equus caballus* is conspicuously flattened ventrally.

*Vertebrae*.—The cervical series (pl. 31, fig. 1) is about as long as in the Arabian horse, but in most cases somewhat slenderer. Compared with the large zebra the neck is a little longer and relatively perhaps a little slenderer. Except for less width across the posterior articular surfaces, the atlas shows no significant characters distinguishing it from that of the recent horse. The neural spine of the axis is distinctly less outstanding and less convex in the fossil form than in either *E. caballus* or *E. grevyi*, and the width of the anterior articular surface for the atlas is less than in *E. caballus*. In the

remaining portion of the series the centra are about the length of those in the Arabian horse; however, the length measured dorsally over the anterior and posterior zygapophyses is relatively less, particularly in the third, fourth, and fifth cervicals, on account of the smaller size of the articular facets and less overlap of the zygapophyses between these vertebrae than in either *E. caballus* or *E. grevyi*. The width across the transverse processes and across the prezygapophyses and postzygapophyses is variable but generally less than in the Arabian horse at hand.

The dorsal vertebrae (pl. 30) show marked variation in size, in length and robustness of the spines, and in the development of the processes but nevertheless exhibit in the articulated series a few characters that appear to be significant. The length of the dorsal series is distinctly longer in mature individuals than in either the Arabian horse or the zebra material used to compare with. The individual vertebrae appear to be about the size of those in the Arabian horse, but the centra are relatively longer, distinctly longer than in the *E. grevyi* column. The spines on the average are slightly shorter and in several instances appear more backward directed in the anterior portion of the series than in *E. caballus*, and after about the sixth or seventh vertebrae the vertebral canal is usually closed posteriorly. After the first or second dorsal the width across the zygapophyses is noticeably less in the fossil material, in which respect the vertebrae are like those in *E. grevyi*. Also, the metaphyses though variable in size and shape project forward more noticeably than in the *E. caballus* material at hand, and in the posterior part of the series are slender and elongate as in *E. grevyi*. The posterior portion of the dorsal series though maintaining relatively long centra are generally not so enlarged as in the *E. caballus* column.

The relatively long centrum characterizing the dorsal vertebrae is carried back in the lumbar and in most cases is noticeably slenderer than in the *E. caballus* and *E. grevyi* material. The spines and transverse processes are highly variable in length and robustness, with the spines commonly elongate and moderately slender. The metaphyses though apparently more distinct from the prezygapophyses than in the *E. caballus* material are reduced posteriorly more noticeably than in *E. grevyi*. Although the individual vertebrae are normally separate in the posterior portion of the series the last two may be fused together (pl. 31, fig. 2), as in some recent individuals, and in a few cases fused to the sacrum.

As in the dorsal and lumbar vertebrae the segments of the sacrum appear relatively elongate anteroposteriorly. The width is variable but across the anterior portion is a little less than in the *E. caballus* material. The distance across the lateral surfaces for articulation

with the transverse processes of the sixth lumbar is about equal to that in the *E. grevyi* skeleton, distinctly less than in the *E. caballus* material.

The caudals show little of interest; however, in comparison with recent material the neural arch is apparently completed in a greater number of the proximal elements. In several individuals the first one or two caudal vertebrae are fused with the sacrum (pl. 31, fig. 2).

*Sternum and ribs.*—The segments of the sternum are preserved in only a few individuals, and these are badly crushed and distorted but apparently are not otherwise distinguishable from modern material. A certain quantity of fragmentary material representing sternal ribs is included in the collection, but these elements, being essentially cartilaginous in the animal during life, are very spongy and without significant shape.

The size of the ribs in these animals appears to have varied considerably between individuals. Some correspond favorably in length and curvature with those in the *E. grevyi* skeleton; in other specimens the ribs are larger than in the Arabian horse. Generally, however, they appear relatively broader than in either form and perhaps more deeply grooved on the inner side and externally, although these cavities may have been emphasized largely by crushing. The first few ribs in most cases are shorter and heavier than in the Arabian skeleton.

*Scapula.*—The scapulae vary appreciably in size but perhaps average shorter than in *E. caballus*. Few differences were observed in the fossil material to distinguish it from modern forms. The glenoid surface for articulation with the humerus appears relatively long anteroposteriorly, in part because of the forward extension of the anteromedian portion of this surface. In *E. grevyi* and *E. caballus* the glenoid surface appears transversely wider, with the inner portion short anteroposteriorly and the portion external to the glenoid notch projecting more forward of that inward from the notch. Moreover, in the fossils a heavier ridge extends from the inner half of the glenoid surface to the coracoid process, approaching in strength the ridge between the outer portion of the glenoid surface and the large tuber scapulae, giving this region a wider anteroventral aspect. A depression of varying markedness extends from the glenoid notch to the coracoid dividing the tuberosity into two processes. An approach is seen in the development of the inner ridge between the glenoid surface and coracoid process in *E. grevyi*. It is least developed in the *E. caballus* scapulae observed.

*Humerus.*—The humerus (pl. 32, figs. 3, 4; pl. 33, figs. 3, 4) corresponds closely in size to that in *E. grevyi* and is more uniform than in *E. caballus*, which commonly possesses a much larger humerus.



The fossil humeri are distinctly *Equus*-like but show a few differences from the modern form. The ridge between the bicipital grooves on the anterior surface of the proximal end is distinctly less outstanding (pl. 33, figs. 3, 4) and somewhat shorter longitudinally than in *Equus*. The greater or lateral tuberosity projects anteriorly to a noticeable extent although relatively not so much as in earlier horses. The ridge external to the bicipital grooves continues distally a short distance on the anterior surface somewhat more prominent on the average than in *Equus grevyi*, and the anterior face of this portion of the humerus may be somewhat narrower. The deltoid tuberosity is prominent but generally not so rugged, and the rugose portion is not developed longitudinally to the extent seen in mature *E. grevyi* humeri. On the distal portion of the humerus the epicondyles appear in most specimens to close proximally over the olecranon or supratrochlear fossa somewhat more acutely than in the few humeri of *E. grevyi* observed.

*Radius and ulna*.—The fused radius and ulna (pl. 32, figs. 7, 8; pl. 33, figs. 7, 8) are about the size of those in *E. grevyi*, somewhat shorter than in most *E. caballus*, and show little to distinguish them from the corresponding parts of the modern forms. The olecranon is relatively deeper fore and aft and perhaps somewhat shorter in length on the average, and the inner surface shows a broad excavation, which is much more conspicuous than in modern ulnae observed. The shaft of the ulna is much reduced, the degree of reduction as in the living horses varying from a continuous sliver to complete absence from most of the distal half of the radius. The distal extremity of the ulna is fused with the radius and articulates with the cuneiform and pisiform. The width across the articulating surfaces on the distal end of the radius in most of the fossil specimens is less than in the few modern radii available.

*Carpus*.—The proximal or radial surface of the scaphoid is strongly flexed with the posterior portion wide and turned upward posteriorly. The notch on the lunar side of the radial surface of the scaphoid is deep and placed about as in specimens of *E. grevyi*. In *E. caballus* the notch appears shallow and nearer the posterior margin. On the external side the distal facet for the lunar appears larger in the fossil material than in *Equus*. On the distal surface the confluent facets for the trapezoid and magnum are generally somewhat constricted anteroposteriorly at the line of contact. The inner or medial surface usually shows a strong tubercle anteroproximally as in *E. grevyi* but more prominent than in the *E. caballus* scaphoids observed.

The posterior concavity on the proximal surface of the lunar is strong as in the scaphoid and shows less tendency to be convex transversely than in *E. caballus* and forms a sharper angle with the portion

of the radial facet on the scaphoid side of the lunar. The posterior extremity of the radial facet projects upward sharply.

The cuneiform varies appreciably in proportions and in size and shape of the facets. As in other carpal elements there is very little to distinguish it from the cuneiform in *E. grevyi* and *E. caballus*. The facet for the pisiform in most specimens is not so elongate as in the few cuneiforms of *E. caballus* at hand.

The pisiform corresponds closely to that in *E. grevyi* and *E. caballus* and in the highly variable facets shows no differences from these forms. The posterior portion is relatively thick transversely and is generally less expanded dorsoventrally than in the recent material.

The trapezium, as indicated by the faceting on the trapezoid, was originally present in nearly every case. However, in the collections the trapezium is present only in the fore feet that were disarticulated in the laboratory. Their scarcity is due no doubt to their small size, hence being overlooked in the field. The bone is either nodular or flattened and from the trapezoid is directed backward and toward the outer side of the foot, presenting a convex posteromedian surface and a longitudinally concave surface facing outward and toward the body of the carpus. Matthew<sup>34</sup> has inadvertently shown the trapezium in articulation primarily with the scaphoid in the Blanco skeleton. The known Hagerman specimens vary from 11 to 18 mm in length, with articular facets 8 to 13 mm long. None of these show facets for articulation with the second metacarpal, although such articulation probably occurred in many individuals. In *E. caballus* the trapezium is considered to be present in about half the cases, and in most of these no articulation occurs with the trapezoid.



FIGURE 23.—*Plesippus shoshonensis* Gidley. Left trapezoid, U. S. N. M. no. 13827, posterior view showing facet for trapezium. Natural size. Hagerman lake beds, upper Pliocene, Idaho.

The trapezoids vary appreciably in size, particularly in the length of the projection carrying the posterior facet for the magnum. The facet for the trapezium is nearly always large and clearly indicated (fig. 23). It is continuous with the large facet for the cuneiform, although in many cases it is set off by a marked transverse constriction of the surface. In only 3 cases out of 72 is the facet for the trapezium absent. In these instances the smooth surface does not extend entirely or nearly to the distal facet for the inner splint bone; however, it is not unlikely that a trapezium existed but perhaps did not make contact with the trapezoid. In the limited *Equus* material at hand only one pair of *E. caballus* trapezoids showed distinct facets for trapezia, and two of the three pairs of *E. grevyi* trapezoids.

The magnum is close in size to that in the large zebra or in the Arabian horse. The surface for articulation with the lunar is more

<sup>34</sup> Matthew, W. D., Quart. Rev. Biol., vol. 1, fig. 21, p. 163, 1926.

constricted between the anterior and posterior portions than in the modern material observed. On the distal surface the posterior portion of the facet for the third metacarpal averages distinctly narrower than in the *Equus* material.

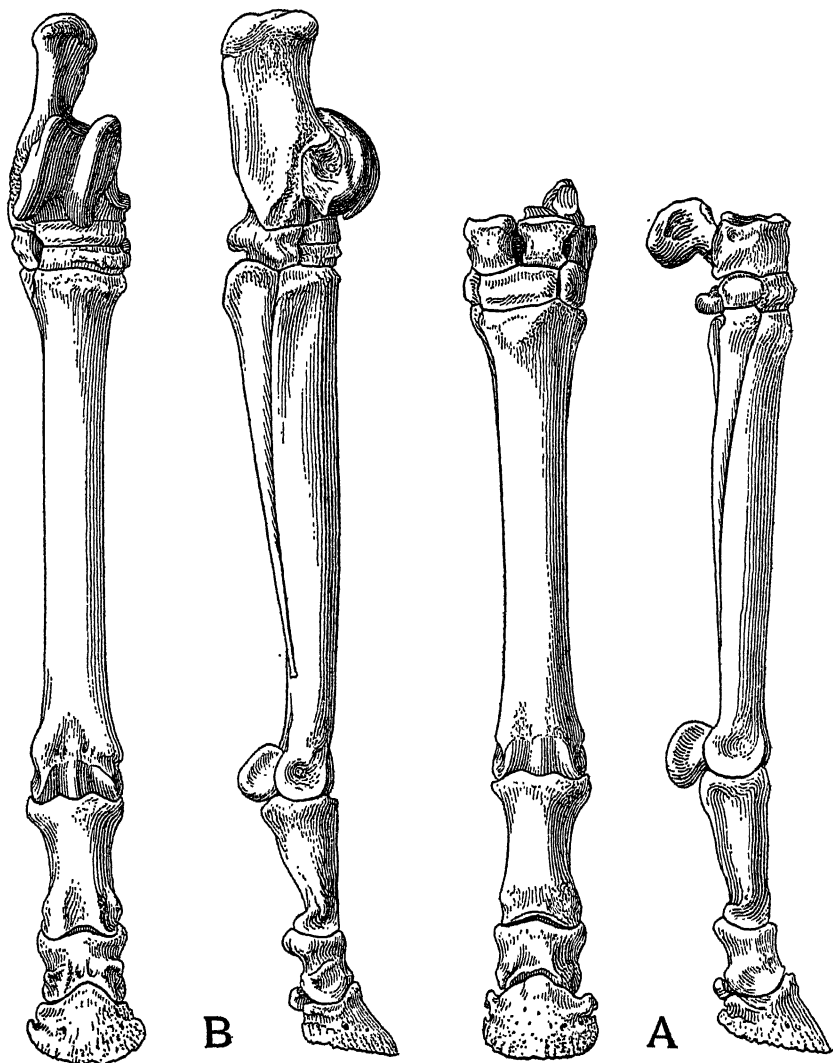


FIGURE 2A.—*Pleistippus shoshonensis* Gidley: A, Articulated left fore foot, U.S.N.M. no. 13794, anterior and medial views; B, articulated right hind foot, U.S.N.M. no. 13792, anterior and lateral views. One-fourth natural size. Hagerman lake beds, upper Pliocene, Idaho.

The unciform shows marked variation in the relative size and shape of the articular facets and in the length of the process projecting postero-internally. The facet for articulation with the cuneiform in

many specimens is relatively narrow and slightly more concave transversely than in *E. caballus* or *E. grevyi*, although in other specimens the difference is not apparent. The proportion of the distal surface resting on the external splint varies appreciably but in a number of specimens appears somewhat smaller than in the few unciforms of *Equus* at hand.

*Metacarpus*.—The third metacarpals (fig. 24, A) are remarkably uniform in size over a large number of specimens, the extremes differing about 23 mm in length. The bone is near in size to that of *E. grevyi*, but with the extremities slightly narrower in most of the specimens. The third metacarpal in *E. caballus* shows a far greater range in size between individuals and the distal portion is relatively much wider and thicker than in the fossils. Also the distal articulating surface extends farther up the posterior surface than in the fossil.

The second and fourth metacarpals or splint bones appear relatively heavy and average somewhat greater in length than in *E. grevyi* and *E. caballus*. The distal extremity in many is flattened and expanded but perhaps not enlarged to the extent seen in some recent horses.

A fifth metacarpal has been observed in only one specimen, and in this case it was smaller than the trapezium that was also present. The bone is nodular in shape and about 11.5 mm long, with a small facet on one side. The proximal end of the fourth metacarpal in this individual is relatively short anteroposteriorly, with the faceted proximal surface carried a very short distance down the posterior surface, presumably for the fifth metacarpal. The vestigial fifth metacarpal if originally present in a larger number of individuals, left no certain indication on either the fourth metacarpal or unciform of its more general occurrence. It is rarely found in *Equus*.

The proximal sesamoids articulating with the posterior portion of the distal articulating surface are variable in size but relatively narrower than in *E. caballus* and possibly than in *E. grevyi*.

*Anterior phalanges*.—The first two phalanges (fig. 24, A) of the fore foot, though not so much shorter than in *E. caballus*, are very much narrower. The terminal phalanx or hoof is considerably smaller than in an average horse, and the anterior surface is more steeply inclined. The phalanges compare favorably with those in the zebra, although the proximal end of the first phalanx is somewhat deeper anteroposteriorly.

*Innominate bone*.—The pelvic girdle shows considerable variation in size and proportions between individuals due in part to age differences and in a large measure to sex dimorphism. Other than perhaps a smaller average size no significant differences were detected to distinguish the pelvis from that in modern horses.

*Femur*.—The length of the femur corresponds to that in *E. grevyi* or moderate-sized individuals of *E. caballus*, but the extremities appear somewhat slenderer on the average (pl. 32, figs. 1, 2; pl. 33, figs. 1, 2). The width of the proximal end across the head and anterior portion of the greater trochanter is generally less, and the neck below the head may be more constricted anteroposteriorly. Between the lesser trochanter and the third trochanter the anterior face of the shaft is commonly narrower or less flattened anteriorly, although not in every case. On the distal end of the femur the distance between the epicondyles averages less and the articular surfaces of the condyles are slightly narrower. The distance from the anterior surface of the trochlea to the posterior surfaces of the condyles is also somewhat less in most specimens than in *E. grevyi* or *E. caballus*. It is possible that most of these differences and many of those in other parts of the skeleton would disappear were a larger series of modern skeletons available; however, it is likely that in many cases an average difference would be maintained.

The patellae do not exhibit any characters of special interest and apparently do not differ in any important respect from those in *Equus*.

*Tibia and fibula*.—The tibia (pl. 32, figs. 5, 6; pl. 33, figs. 5, 6) is of moderate size, and, as observed in the femur, the proximal and distal portions are slightly less in diameter than in a large zebra or an Arabian horse. The articular facets average smaller than in the available modern tibiae of about the same length. The cnemial crest appears prominent and rugged as in modern forms.

In the few fibulae (see figs. 5 and 6 of pls. 32 and 33) preserved it appears, as observed by Matthew in the Blanco material, that reduction has progressed to a greater extent than in modern *Equus*. The fibula tapers abruptly and where complete is found to terminate at 7 or 8 cm, or a small fraction of the length of the tibia, whereas in the *Equus* skeletons observed the fibula extends about halfway down the tibia, or somewhat farther.

*Tarsus*.—The astragalus is surprisingly conservative in form although it shows a range in size variation. Astragali in *E. grevyi* and *E. caballus* correspond closely in detail to those in the fossil form and show no important differences other than perhaps a somewhat greater backward extent of the proximal portions of the trochlear ridges, and a greater size range in the *E. caballus* material.

The calcaneum is about as large as in *E. grevyi* or an Arabian horse and shows little to distinguish it from *Equus*. The sustentaculum is less prominent than in the Arabian horse, and the long axis of the sustentacular facet is more nearly parallel to the vertical axial plane. In the specimen of an Arabian horse the sustentacular facet in both

the astragalus and calcaneum is directed downward and more inward than in the fossil material. In other *Equus* specimens the inward projection of this facet is not so pronounced.

The posterior margin of the navicular in many cases is more deeply notched than in the *E. grevyi* material, noticeably in the outline of the facet for the astragalus as this surface extends well out onto the postero-internal prominence. On the distal surface the smaller facets are irregular in size and shape and may or may not be confluent with the larger facet for the external cuneiform.

The fused internal and middle cuneiforms present an irregular shape and vary in size among individuals. The anterior and posterior portions of the proximal facet for the navicular may be broadly confluent or nearly separate. On the distal surface the facets for the second metatarsal may be distinct or meet at a sharp angle. The size of the facet for the third metatarsal is variable though generally small. No persistent differences were observed in comparison with modern material. In one of the fossil skeletons the internal and middle cuneiforms were found separated, as was also observed in one of the recent individuals of *E. caballus*.

On the external cuneiforms the proximal facets for the navicular are commonly separated but those on the distal surface for the third metatarsal are generally continuous between the anterior and posterior portions. In nearly every specimen the external cuneiform shows a facet postero-internally for articulation with the second metatarsal. In *Equus caballus* articulation between these bones is much less common, and none of the material at hand shows evidence of it, although two of the three observed pairs of ectocuneiform bones belonging to *E. grevyi* show facets for the inner splint.

On the proximal surface of the cuboid the width anteriorly across the facets for the astragalus and calcaneum appears narrower in much of the material, and the surface is perhaps more convex transversely than in the *E. caballus* material at hand. Also, the posterior portion of the facet for the calcaneum is not directed inward so noticeably in most of the fossils. On the distal surface the facet for the fourth metacarpal though varying appreciably in size is almost always undivided. The few *E. caballus* cuboids observed show the facet for fourth metacarpal divided and with the posterior segment distinctly small. The cuboids in the *E. grevyi* material more closely correspond to those in the fossil form.

*Metatarsus*.—The third metatarsals (fig. 24, B), as in the case of the third metacarpals, show a certain uniformity and correspond nearly in size to that in *E. grevyi*. The extremes of length differ by about 20 mm. The size range is far less than in *E. caballus*, and the distal articular surface is relatively much narrower transversely and does not extend so far up the posterior surface as in the specimens of that

species examined. The distal portion, however, appears relatively deep anteroposteriorly as compared with *E. grevyi*. The distal portion is deep relative to its width in comparison with *E. caballus*, although the keel is less outstanding.

The splint bones are robust proximally, particularly the outer, and the length where complete is variable but apparently averaging somewhat longer than in recent material. They taper or flatten distally and may be slightly expanded at the end but the enlargement is not so pronounced as in some recent horses. The second metatarsal usually shows a facet of variable size for articulation with the external cuneiform.

The proximal sesamoids articulating with the distal surface of the third metatarsal are smaller than in the front foot, and as in the latter are relatively narrower than in *E. caballus*.

*Posterior phalanges*.—The phalanges of the hind foot (fig. 24, B), as in the fore foot, are much narrower than in *E. caballus* and more closely approach the proportions seen in *E. grevyi*. There is little difficulty in distinguishing between phalanges of the fore and hind foot of one individual but with isolated toe bones identification is often uncertain. The first phalanx of the hind foot is a little shorter, the proximal end a little heavier, and the distal end narrower. The second phalanx is narrower and perhaps a little longer. The hoof is somewhat narrower, and the anterior margin though not pointed is less rounded than in the fore foot. The right and left sides may be distinguished by the slight asymmetry of the elements, very readily in the first phalanx but not so easily in the distal element.

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TABLE 1.—*Measurements (in millimeters) of skull and superior dentition\**

Measurement	<i>Pleistypus shoshonensis</i>						<i>P. simpli-</i> <i>cidentis</i>	<i>Egypus</i> <i>scottii</i>
	U.S.N.M. no. 12494, immature	U.S.N.M. no. 12541, ♀	U.S.N.M. no. 12542, ♂	U.S.N.M. no. 12573, ♂	U.S.N.M. no. 12543, ♀	U.S.N.M. (type), ♂	U.S.N.M. no. 12535, ♀	Amer. Mus. no. 10600 (type), ♀?
Vertex length, from median incisive border to middle of occipital crest.....	521	593	612	♂ 612	620	637	♂ 588	♂ 600
Basilar length, from median incisive border to anterior edge of foramen magnum.....	403	529	527	535	542	561	♂ 509	♂ 535
Facial length, from median incisive border to line between posterior borders of orbits.....	♂ 327	421	432	430	♂ 434	456	♂ 416	♂ 419
Cranial length, from line between posterior borders of orbits to middle of occipital crest.....	♂ 160	179	♂ 187	♂ 191	♂ 187	184	♂ 183	♂ 185
Frontal width at posterior borders of orbits.....	♂ 200	♂ 210	228	♂ 228	♂ 240	♂ 225	♂ 230	♂ 220
Width across outer margins of glenoid fossae.....	103	♂ 211	218	---	♂ 224	---	♂ 212	♂ 198
Vertical diameter of orbital cavity.....	48.7	♂ 52	---	---	---	55	58.4	♂ 56
Horizontal diameter of orbital cavity.....	58	63.5	♂ 65	---	---	64.3	♂ 62	72.5
Convexity of nasofrontal suture, distance from anterior extent of suture to line between posterior extremities of suture.....	23	31	32.5	---	---	---	---	♂ 25
Distance from posterior border of palate to middle of posterior edge of vomer.....	131	133	140	154	149	---	140	♂ 138
Distance from middle of posterior edge of vomer to anterior edge of foramen magnum.....	94	108	109	98	♂ 110	---	♂ 95	♂ 118
Craniofacial angle (between basifacial and basicranial lines).....	22°	27°	20°	23°	25°	---	♂ 27°	♂ 16°
Diastema between P <sup>3</sup> and P <sup>4</sup> .....	94	109	90.2	103	115	125	♂ 105	♂ 125
Muzzle width at posterior alveolar borders of P <sup>3</sup> .....	61.2	72.3	♂ 72	♂ 75	71.5	71.5	73.7	♂ 80
Width of palate between P <sup>1</sup> .....	52.3	♂ 49.5	61.1	45.2	55.7	---	♂ 47	♂ 51
Length, P <sup>1</sup> -M <sup>3</sup> at wearing surface.....	202	198	190	190	183	188	181	185
Length, P <sup>2</sup> -P <sup>4</sup> at wearing surface.....	114	108	106	106	108	104	97	♂ 104
Length, M <sup>1</sup> -M <sup>4</sup> at wearing surface.....	92	94	94	85.5	88	86.9	84.2	♂ 92
P <sup>1</sup> , anteroposterior diameter.....	13.4	14	19.8	9.2	15.9	15	18.2	♂ 33
P <sup>2</sup> , anteroposterior diameter.....	♂ 35	36.5	34.5	32.9	33	31.2	30.9	♂ 32.5
P <sup>3</sup> , greatest transverse diameter excluding cement.....	♂ 25	31.5	30.3	30.7	29	32.4	29.1	♂ 29
M <sup>1</sup> , anteroposterior diameter.....	---	32.9	32.3	30	30.5	28.1	26.5	♂ 30.8
M <sup>2</sup> , greatest transverse diameter excluding cement.....	---	27.5	26.4	29	27.7	29.7	28.4	♂ 30
Approximate age (in years).....	1	4.5	4.5	5	5	15	25-30	3.5

\* Cranialmetry in large part follows Osborn.

♂ Approximate.

♂ Estimated.

♂ Deciduous teeth.

TABLE 2.—Measurements (in millimeters) of mandible and inferior dentition

Measurement	<i>Pleistippus shoshoneensis</i>						<i>Equus scotti</i>	
	U.S.N.M. no. 12560, immature	U.S.N.M. no. 12541, ♀	U.S.N.M. no. 12563, ♂	U.S.N.M. no. 12573, ♂	U.S.N.M. no. 12504, ♀	U.S.N.M. no. 11966 (type), ♂	U.S.N.M. no. 12552, ♂	Amer. Mus. no. 10006 (type), ♀?
Length of mandible from base of central incisor to posterior margin of condyle.....	400	482	471	493	470	507	472	467
Height of mandible from condyle to base.....	204	258	223	222	255	257	214	249
Width of symphysis.....	54	70	60	63	61.6	59.2	60.4	67
Depth of jaw at posterior border of M <sub>1</sub> .....	80	141	120	120	135	122	117	135
Depth of jaw between P <sub>4</sub> and M <sub>1</sub> .....	63.7	100	90	88.8	92.4	92	90	97
Depth of jaw between P <sub>3</sub> and P <sub>4</sub> .....	86.3	102	74.5	78	79.5	81	81.2	83
Diastema between I <sub>1</sub> and P <sub>2</sub> .....	---	102	98.3	97	96.4	127	95.5	110
Length, P <sub>2</sub> -M <sub>1</sub> , along alveoli.....	---	206	189	195	192	185	188	190
Length, P <sub>2</sub> -M <sub>3</sub> , along wearing surface.....	---	200	184	190	187	185	181	180
Length, P <sub>2</sub> -P <sub>4</sub> , along wearing surface.....	107	107	98	105	100	93	94	93
Length, M <sub>1</sub> -M <sub>3</sub> , along wearing surface.....	---	94.1	86	89	88.1	92	86.7	80.4
P <sub>3</sub> , anteroposterior diameter.....	33.5	35.2	31.2	33	32.4	29	30.2	28.5
P <sub>3</sub> , transverse diameter excluding cement.....	12.7	18.5	17.1	17.8	17.2	---	16.7	14.6
M <sub>3</sub> , anteroposterior diameter.....	---	33.5	29.1	30.7	29	28	27.5	25
M <sub>3</sub> , transverse diameter excluding cement.....	---	14.5	13.8	14.2	14.7	---	14.2	13.5
Approximate age (in years).....	1	4.5	5	5	5	15	15-20	3.5

\* Approximate.

\* Teeth only slightly worn.

\* Estimated.

TABLE 3.—Measurements (in millimeters) of vertebrae

Measurement	<i>Pleistippus shoshonensis</i>					<i>P. simplicioides</i>	<i>Equus scotti</i>
	U.S.N.M. no. 13792	U.S.N.M. no. 13794	U.S.N.M. no. 12155	U.S.N.M. no. 12573	U.S.N.M. no. 12578	Amer. Mus. no. 20076	Amer. Mus. no. 10808-7-9
Length of articulated cervical series.....	• 910	• 785	• 592	• 558	—	• 660	• 680
Length of articulated dorsal series.....	32	35	• 810	—	—	• 700	• 900
Width across anterior articular surface on centrum of fourth dorsal.....	• 305	• 290	—	• 34	—	• 87	• 38
Length of articulated lumbar series.....	38.3	36	39	—	• 310	• 305	• 330
Width across anterior articular surface on centrum of third lumbar.....	• 207	• 206	• 207	—	41	37	45
Length of sacrum measured along centra.....	—	—	—	—	—	—	210

• Approximate.

• Estimated.

TABLE 4.—Measurements (in millimeters) of fore limb

Measurement	<i>Platypus shoshonensis</i>						<i>P. simplicidens</i> Amer. Mus. no. 20076	<i>Equus scotti</i> Amer. Mus. no. 10006-8
	U.S.N.M. no. 13795	U.S.N.M. no. 13791	U.S.N.M. no. 13794	U.S.N.M. no. 12576	U.S.N.M. no. 12573	U.S.N.M. no. 12577		
Greatest length of scapula.....	• 338	• 357	396	320	• 392	354	373	350
Greatest width of scapula.....	281	• 180	-----	196	• 184	176	• 195	• 173
Length of humerus from head to inner condyle.....	105	• 272	• 280	267	• 278	• 280	287	295
Width of proximal end of humerus.....	81.5	78	76	78	• 84.5	76	• 80	89
Width of distal articular surface of humerus.....	85.5	83	88.4	85.7	• 90	83	• 84	98.5
Distance across inner surface of condyle and epicondyle of humerus.....	436	402	• 426	-----	424	415	429	428
Greatest length of fused radius and ulna.....	336	316	334	-----	324	321	• 334	334
Length of radius between articular surfaces measured along inner side.....	81.3	77	-----	74	81.5	77	• 80	• 78
Length of olecranon from sigmoid notch.....	79.9	77.3	• 75	76	82	74.5	82	87.5
Width of proximal articular surface of radius and ulna.....	63.8	62	62.8	-----	66	60	• 64	72.7
Greatest length of third metacarpal.....	250	246	254	242	-----	240	• 252	• 238
Width of proximal articular surface of third metacarpal.....	50.9	50	49	46.5	53	48.5	51.2	56
Depth of proximal articular surface of third metacarpal.....	33.5	31.7	32.5	30	33.3	31.5	• 34	37
Width across distal articular surface of third metacarpal.....	46.6	44.2	47.2	43.5	47.8	43.3	46	56.8
Depth of inner portion of distal articular surface of third metacarpal.....	33.1	30.8	32.7	30.9	32.7	30.3	33.2	36.5
Depth across keel of distal articular surface of third metacarpal.....	35.8	34.7	36.9	34.6	36.0	32.3	34	42.3
Length of inner splint bone.....	-----	• 185	193	• 186	183	• 177	-----	160
Length of outer splint bone.....	-----	-----	180	-----	177	179	179	170
Greatest length of first phalanx.....	87.3	82.5	86.2	85	86.2	86	• 86	• 92
Width of proximal end of first phalanx.....	60.2	48.5	51	47.9	50.5	46	53.2	60.5
Depth of proximal portion of first phalanx.....	36.5	36	36	34.2	38.5	36	37	41
Width of distal articular surface of first phalanx.....	43	39.9	41.7	40	41.6	39.5	43.5	50
Greatest length of second phalanx.....	49.9	43.6	47.9	47	48	46.6	• 48	• 48
Width of proximal end of second phalanx.....	51	47.6	48.7	50.7	50.7	47	50.5	57.9
Depth of proximal portion of second phalanx.....	32.1	30	31	30.8	31.3	30.5	32.2	33
Width of distal articular surface of second phalanx.....	46.3	44.4	45.2	41.5	45	42	47.4	51
Distance from extensor process to anterior extremity of hoof.....	-----	48.2	47.3	50	45.2	-----	46	50.3
Distance from anterior extremity of hoof to line between posterior extremities.....	• 60	60	59.5	64.3	56.5	-----	59.3	65
Greatest width of hoof.....	68.7	62.5	59.5	60	59.3	-----	64.3	81.5

• Approximate.

TABLE 5.—Measurements (in millimeters) of hind limb

Measurement	<i>Pterippus shoshonensis</i>					<i>Pterippus simplicioides</i>		<i>Equus scotti</i>
	U.S.N.M. no. 13795	U.S.N.M. no. 13792	U.S.N.M. no. 12576	U.S.N.M. no. 12155	U.S.N.M. no. 13826	Amer. Mus. no. 20077	Amer. Mus. no. 20076	
Length of femur from head to inner condyle.....	374	361	347	370	370	360	366	382
Width of femur across head and anterior portion of greater trochanter.....	126	126	106	120	110	119	125	140
Width of distal end of femur across condyles.....	96.6	94.7	86	99	94	99	99	108
Depth of distal extremity of femur across inner portion.....	124	121	124	121	121	127	119	134
Greatest length of tibia.....	385	370	361	370	370	362	360	358
Width of proximal end of tibia.....	106	98	97	97	98.5	98.9	101	107
Greatest width of distal extremity of tibia.....	78.2	78	73.5	75	72	75.5	73.7	81
Width across distal articular surface of tibia.....	54	54	51	55	54	55	55	62
Length of calcaneum.....	118	116	104	118	119	120	114	127
Length of astragalus on inner side.....	60.5	63	69	61	63	60.5	60	66
Width of astragalus across tuberosities.....	63	62.2	58.5	61.5	61.5	64	63.5	68.8
Length of third metatarsal.....	279	281	276	280	282	270	272	266
Width of proximal articular surface of third metatarsal.....	51	48	48.5	50	49	45	47	54
Depth of proximal articular surface of third metatarsal.....	39	35.5	35	38	38	42	42	47
Width of distal articular surface of third metatarsal.....	47.5	44.8	42.9	46	46.1	47	46	55.2
Depth of inner portion of distal articular surface of third metatarsal.....	33.1	30.5	30	31.3	31.1	34	33	33.8
Depth across keel of distal articular surface of third metatarsal.....	37	35.5	34.2	35.8	36.7	37	36	41
Length of inner splint bone.....	210	219	218	218	218	215	171	184
Length of outer splint bone.....	219	221	219	219	219	212	216	200
Length of first phalanx.....	83	80.2	78.3	79.7	79.6	78	78	87.7
Width of proximal end of first phalanx.....	51.6	49	47	50.2	49.5	52.8	52.4	61.6
Depth of proximal end of first phalanx.....	38.5	37.8	35.4	37.5	38.7	38	37.2	42
Width across distal articular surface of first phalanx.....	40.3	39	38	40.4	38	42	40.7	44.8
Length of second phalanx.....	49.5	47.5	47.2	47.8	47.8	50.2	49	49.5
Width of proximal end of second phalanx.....	49.5	47.7	46.7	45.8	45.8	48	48.7	54.2
Depth of proximal end of second phalanx.....	31.4	31	31	31	31	32	31.5	35.6
Width of distal articular surface of second phalanx.....	42.5	40.5	39.5	38.8	38.8	41	41	48.5
Distance from extensor process to anterior extremity of hoof.....	49	46.5	50.6	48.5	48.5	51	47	61
Distance from anterior extremity of hoof to line between posterior extremities.....	54.6	51.7	54.6	60	60.2	60.2	57	71
Greatest width of hoof.....	65	62	58.9	54	54	58.5	60.5	75.2

\* Approximate.

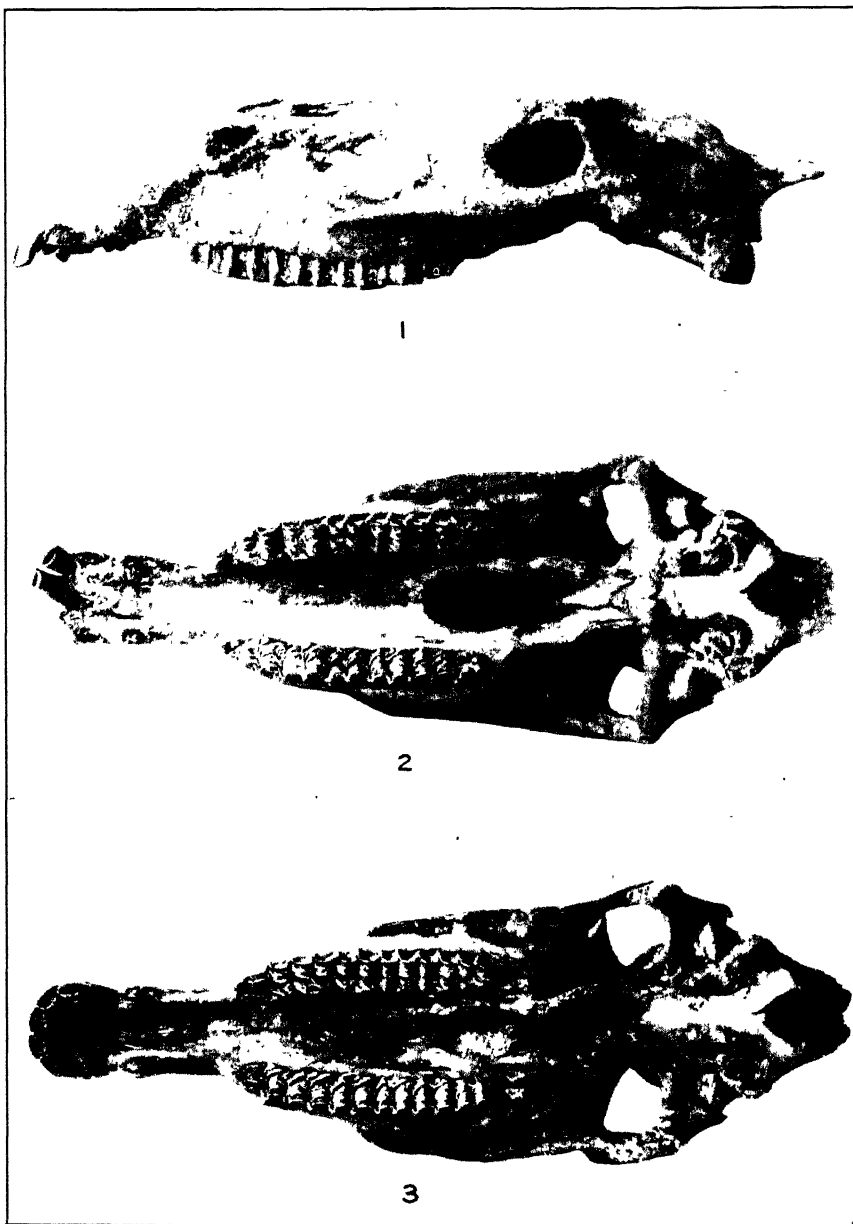


1. View of *Plesippus* quarry and fossil-bearing beds to the south as seen from the desert rim near Hagerman, Idaho.
2. View of the quarry during removal of plaster-encased blocks of *Plesippus* bones. Material can be seen in place in right foreground.



*PLESIPPUS SHOSHONENSIS.*

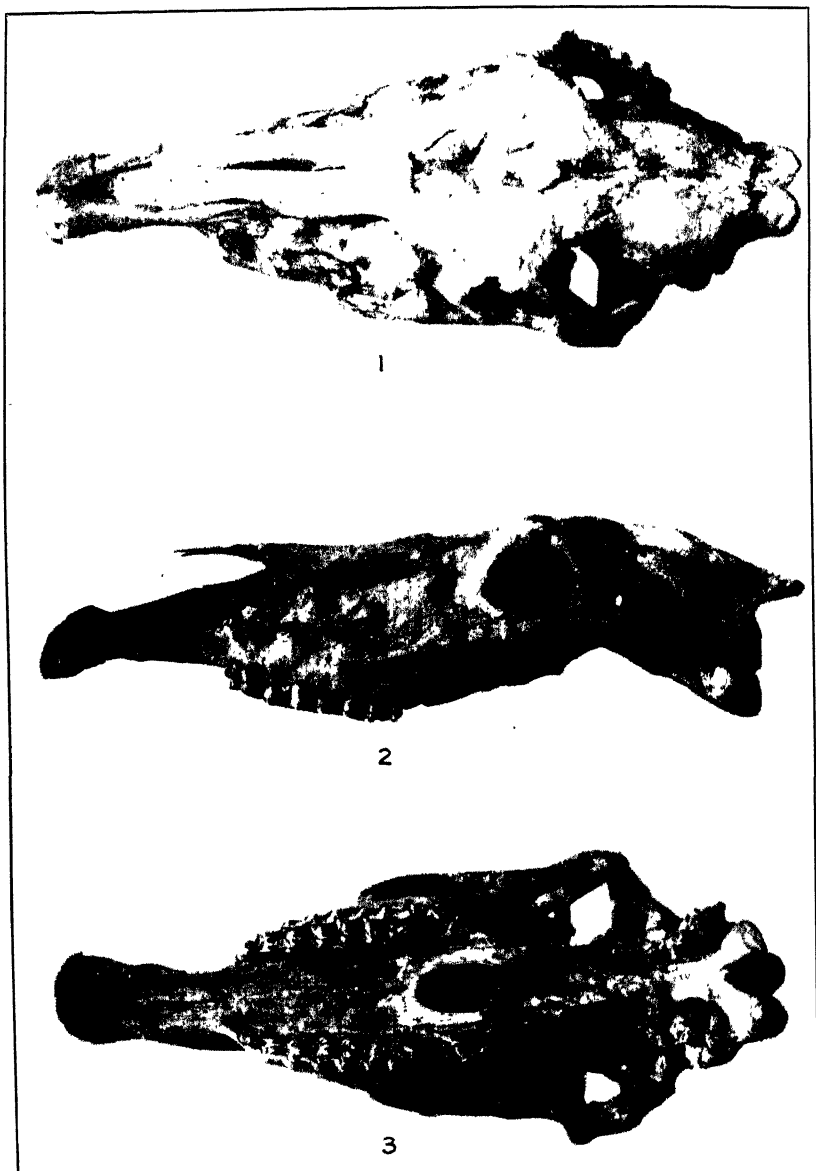
Skull and mandible, type specimen, U.S.N.M. no. 11986: 1, Dorsal view; 2, lateral view. About two-elevenths natural size. Hagerman lake beds, upper Pliocene, Idaho.



*PLESIPPUS SHOSHONENSIS.*

Skulls: 1, U.S.N.M. no. 12542, lateral view; 2, U.S.N.M. no. 12542, palatal view; 3, U.S.N.M. no. 12573, palatal view. About two-elevenths natural size. Hagerman lake beds, upper Pliocene, Idaho.





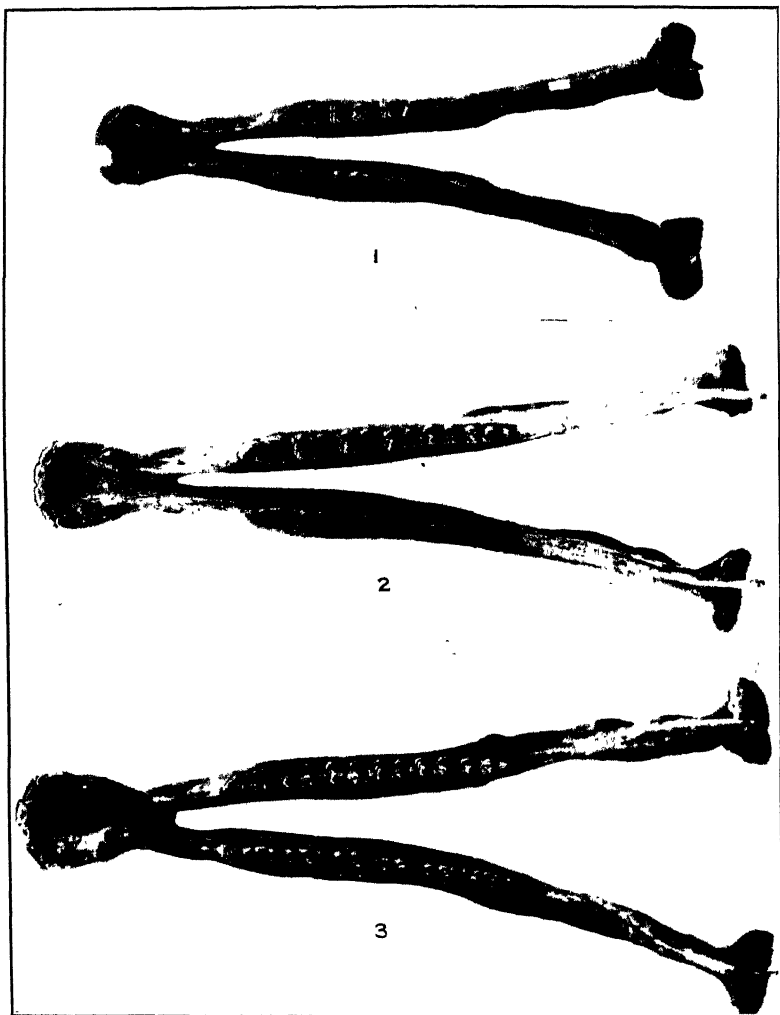
*PLESIPPUS SHOSHONENSIS.*

Skull (immature), U.S.N.M. no. 12494: 1, Dorsal view; 2, lateral view; 3, palatal view. About one-fifth natural size. Hagerman lake beds, upper Pliocene, Idaho.



*PLESIPPUS SHOSHONENSIS.*

Mandibles: 1, U.S.N.M. no. 12560 (immature); 2, U.S.N.M. no. 12553; 3, U.S.N.M. no. 12573. Lateral views. About one-fifth natural size. Hagerman lake beds, upper Pliocene, Idaho.



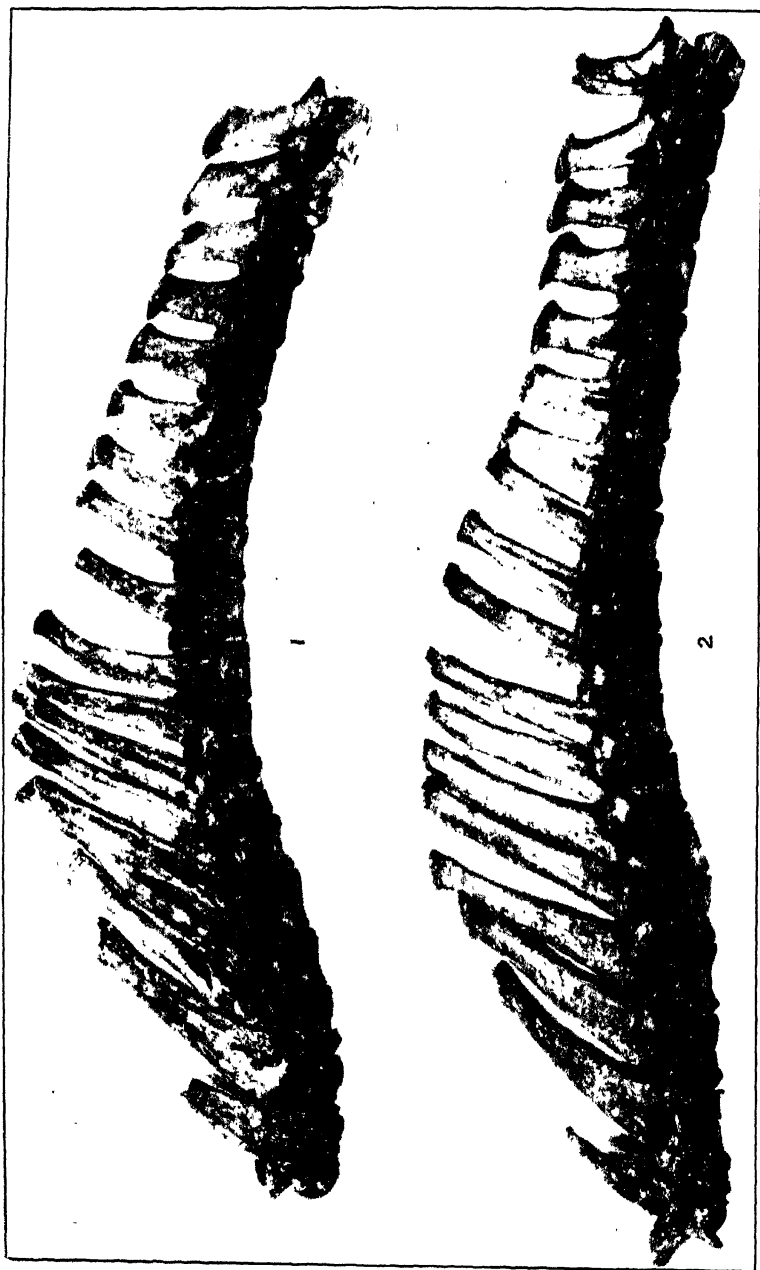
*PLESIPPUS SHOSHONENSIS.*

Mandibles: 1, U.S.N.M. no. 12560 (immature); 2, U.S.N.M. no. 12553; 3, U.S.N.M. no. 12573. Occlusal views. About one-fifth natural size. Hagerman lake beds, upper Pliocene, Idaho.



PLESIPPUS SHOSHONENSIS.

Hyoid bones: 1, U.S. N.M. no. 13792; 2, U.S.N.M. no. 12573. Lateral views of stylhyals and ceratohyals and dorsal views of fused basihyal and thyrohyals. About one-half natural size. Hagerman lake beds, upper Pliocene, Idaho.



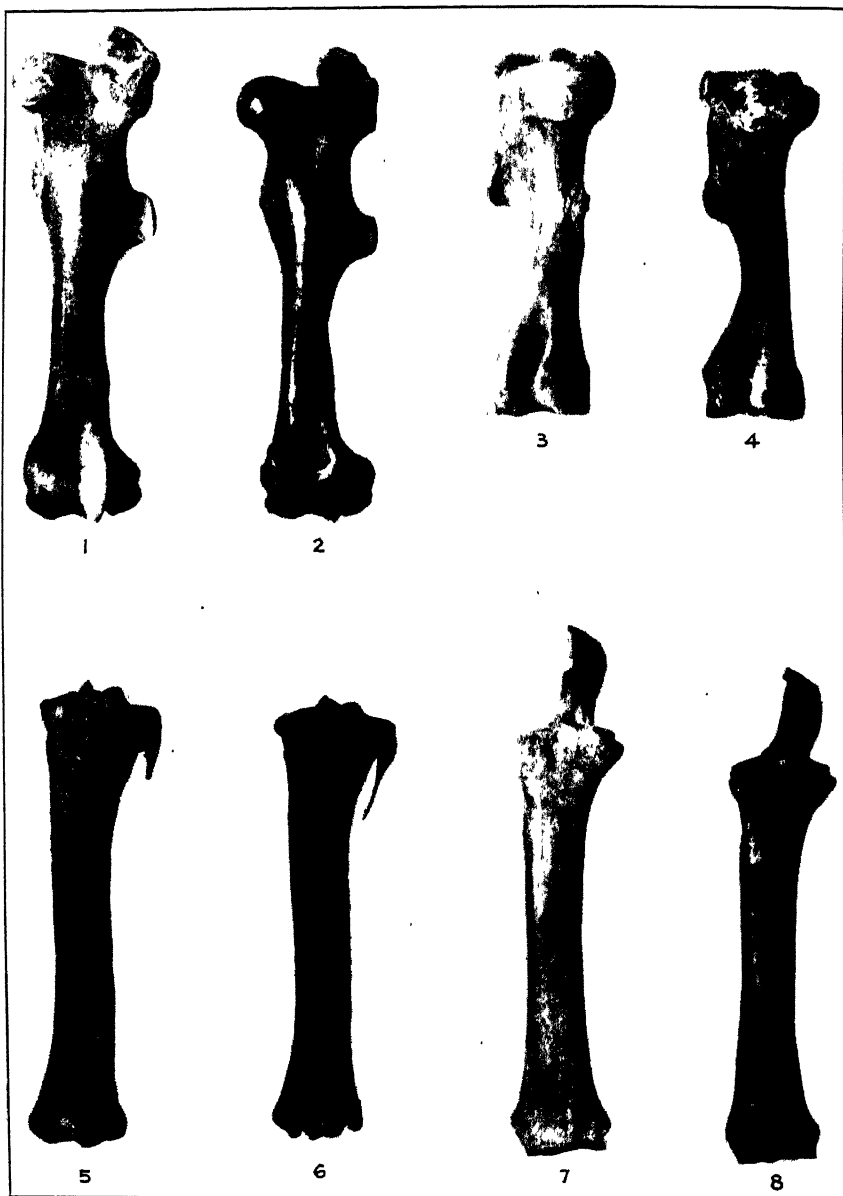
*PLESIPPUS SHOSHONENSIS.*

Dorsal vertebrae: 1, U.S.N.M. no. 13794; 2, U.S.N.M. no. 13792. Lateral views. About three-sixteenths natural size. Hagerman lake beds, upper Pliocene, Idaho.

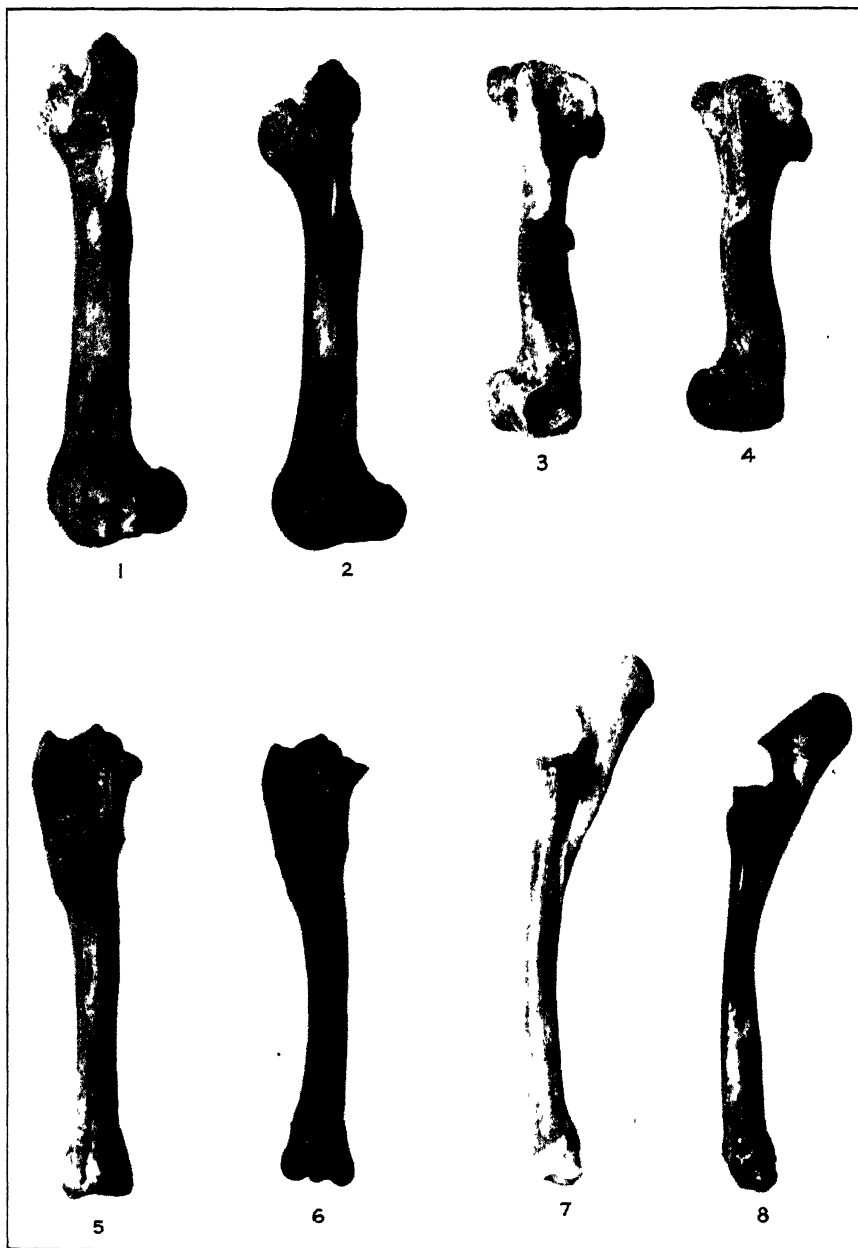


*PLESIPPUS SHOSHONENSIS.*

1, Cervical vertebrae, U.S.N.M. no. 13573, lateral view; 2, lumbar and sacral vertebrae, U.S.N.M. no. 13702, dorsal view. About one-fourth natural size. Hagerman lake beds, upper Pliocene, Idaho.

*PLESIPPUS SHOSHONENSIS.*

Limb bones: 1, Femur, U.S.N.M. no. 13795; 2, femur, U.S.N.M. no. 13815; 3, humerus, U.S.N.M. no. 13795; 4, humerus, U.S.N.M. no. 13814; 5, tibia and fibula, U.S.N.M. no. 13795; 6, tibia and fibula, U.S.N.M. no. 13791; 7, radius and ulna, U.S.N.M. no. 13795; 8, radius and ulna, U.S.N.M. no. 13791. Views of humerus are posterior; all others are anterior. All about one-sixth natural size. Hagerman lake beds, upper Pliocene, Idaho.



**PLESIPPUS SHOSHONENSIS.**

Limb bones: 1, Femur, U.S.N.M. no. 13795; 2, femur, U.S.N.M. 13815; 3, humerus, U.S.N.M. no. 13795; 4, humerus, U.S.N.M. 13814; 5, tibia and fibula, U.S.N.M. no. 13795; 6, tibia and fibula, U.S.N.M. no. 13791; 7, radius and ulna, U.S.N.M. no. 13795; 8, radius and ulna, U.S.N.M. no. 13791. All lateral views. All about one-sixth natural size. Hagerman lake beds, upper Pliocene, Idaho.





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A NEW GENUS AND SPECIES OF TREMATODE FROM THE  
LITTLE BROWN BAT AND A KEY TO THE GENERA OF  
PLEUROGENETINAE

By RALPH W. MACY

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AMONG the intestinal parasites of a little brown bat (*Myotis lucifugus*), collected on February 12, 1934, at St. Peter, Minn., by Gustav Swanson, were 11 specimens of a hitherto undescribed trematode, which was found to belong to a new species of a new genus of Lecithodendriidae. Although the species appears to be more closely related to the members of the Pleurogenetinae than to those of any other group, it can not be referred to any of the existing genera of that subfamily.

**GLYPTOPORUS, new genus**

*Diagnosis.*—Pleurogenetinae: Suckers subequal; testes entire, situated at level of ventral sucker; intestinal ceca short, reaching only to testes; cirrus sac large, mostly lateral and anterior to ventral sucker; genital pore anterior to ventral sucker and slightly to left of median line of body. Seminal receptacle present. Ovary entire, pre-equatorial, and on opposite side of acetabulum to cirrus sac. Vitellaria pretesticular, follicles large and filling region between ceca and oral sucker, with tendency toward a single field. Uterus filling large portion of body. Excretory vesicle V-shaped.

*Genotype.*—*Glyptoporus noctophilus*, new species.

This genus may be distinguished from other genera in the subfamily as shown in the key (p. 323).

## GLYPTOPORUS NOCTOPHILUS, new species

*Specific diagnosis.*—Body elliptical, posterior extremity sometimes attenuate, 0.45 (0.48, 0.53)<sup>1</sup> mm long and 0.32 (0.29, 0.38) mm wide. Cuticula without spines. Oral sucker subterminal, 0.075 (0.066, 0.08) mm long and 0.097 (0.088, 0.09) mm wide. Pharynx 0.03 (0.03) mm long and 0.04 (0.039) mm wide. Esophagus evidently very short (possibly absent). Intestinal ceca short, simple, extend-

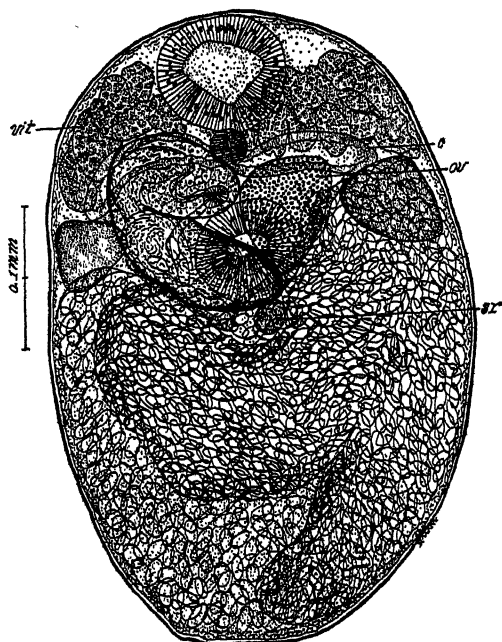


FIGURE 25.—*Glyptoporus noctophilus*, new genus, new species: Dorsal aspect, camera lucida. vit, Vitellaria; c, cecum; ov, ovary; sr, seminal receptacle.

ing laterally to anterior margins of testes. Ventral sucker 0.07 (0.07, 0.073) mm long and 0.076 (0.08, 0.078) mm wide, pre-equatorial. Testes ovate to pyramidal, average length 0.066 (0.066, 0.057) mm, average width 0.062 (0.049, 0.049) mm, placed near body margins and at level of ventral sucker. Cirrus sac large, usually about a third as long as entire body, length 0.153 (0.156, 0.145) mm (distance between extreme anterior and posterior levels rather than actual total length), width 0.056 (0.066, 0.063) mm, mostly anterior and lateral to ventral sucker, strongly recurved. Seminal vesicle voluminous, much convoluted, and ending in a narrow ejaculatory duct. Genital pore anterior to ventral sucker and slightly lateral to mid line of body, closer to ventral sucker than to pharynx. Region

<sup>1</sup> The first measurement given is of the type; the next two are of the paratypes.

immediately surrounding genital pore with minute radiating lines, thus resembling a small genital sucker. This character, however, is more evident in some examples than in others. Ovary oval to pyriform, entire, 0.071 (0.06–0.082) mm long and 0.072 (0.06, 0.063) mm wide, situated on right side of mid line of body and at level of ventral sucker and testes. Seminal receptacle posterior to ventral sucker, 0.035 (0.034) mm in diameter. Vitellaria consisting of coarse follicles, fields reaching from testes to oral sucker, arranged either in slightly separated bilateral groups or in a single field entirely across the body dorsal to the pharynx. Uterus extensive, filling posterior two-thirds of body. Eggs 0.018 to 0.02 mm long and 0.011 to 0.012 mm wide. Excretory bladder V-shaped.

*Host*.—*Myotis lucifugus* (LeConte).

*Location*.—Intestine.

*Locality*.—St. Peter, Minn.

*Specimens*.—Type, U.S.N.M. no. 8947; paratypes in author's collection.

#### KEY TO THE GENERA OF PLEUROGENETINAE

1. Ceca long, uterus usually both post- and pre-acetabular ..... 2  
Ceca short, uterus postacetabular ..... 4
2. Genital pore marginal and pre-acetabular ..... *Pleurogenes* Looss (1896)  
Genital pore at side of acetabulum ..... 3  
Genital pore somewhat lateral, pre-acetabular.  
*Loxogenes*, in part (see Krull, 1933)
3. Cirrus sac club-shaped, extending around acetabulum; acetabulum twice as large as oral sucker ..... *Parabascus* Looss (1907)  
Cirrus sac oval; suckers subequal ..... *Postorchigenes* Tubangui (1928)
4. Genital pore marginal ..... 5  
Genital pore not marginal ..... 8
5. Genital pore pretesticular ..... 7  
Genital pore posttesticular ..... 6
6. Genital pore pre-acetabular ..... *Prosotocus* Looss (1899)  
Genital pore postacetabular ..... *Brandesia* Stossich (1899)
7. Ovary postacetabular ..... *Cryptotrema* Ozaki (1926)  
Ovary pre-acetabular ..... *Pleurogenoides* Travassos (1921b)
8. Genital pore lateral to acetabulum ..... *Limatulum* Travassos (1921b)  
Genital pore not lateral to acetabulum ..... 9
9. Genital pore at posterior tip of pharynx and not in vicinity of acetabulum.  
*Phaneropsolus* Looss (1899)  
Genital pore closer to acetabulum than to pharynx ..... 10
10. Acetabulum equatorial or postequatorial.  
*Loxogenes*, in part, Stafford (1905)  
Acetabulum pre-equatorial ..... 11
11. Testes and ovary lobed; ovary on same side of acetabulum as cirrus sac.  
*Mosesia* Travassos (1928)  
Testes and ovary entire; ovary on opposite side of acetabulum to cirrus sac.  
*Glyptoporus*, new genus

The long ceca of *Loxogenes bicolor* Krull (1933) appear to me to be sufficiently unique in this group to require a division of the genus on that character.

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TWO NEW COTTID FISHES FROM THE WESTERN PACIFIC,  
WITH A REVISION OF THE GENUS *STLENGIS* JORDAN  
AND STARKS

By ROLF L. BOLIN

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THE EXTENSIVE collections made by the United States Bureau of Fisheries steamer *Albatross* in the northwestern Pacific during the cruise of 1906 contain several new species of cottid fishes, two of which are herein described. The drawings for the plate were made by the late William Sackston Atkinson under the direction of the late Dr. Charles Henry Gilbert. The text figures of scales were drawn by me. I am greatly indebted to Dr. George S. Myers, of the United States National Museum, for detailed information concerning the type and only known specimen of *Stlengis osensis*.

In their review of the Cottidae of Japan, Jordan and Starks<sup>1</sup> described two rather closely related species under the names *Stlengis osensis* and *Schmidtia misakia*. The two new genera to which these fishes were allocated were distinguished from each other by the character of the squamation alone, there being three longitudinal scale bands in *Stlengis* and one in *Schmidtia*. *Stlengis distoechus*, the new species described below, is an intermediate form having two bands of scales.

While the three fishes show marked differences in squamation, the strong tendency to reduce and modify scales, which is expressed by

<sup>1</sup>Proc. U. S. Nat. Mus., vol. 27, pp. 231-335, 43 figs., 1904.

the bewildering variation in this regard throughout the entire family, lessens the apparent evolutionary significance of changes in these structures. *Stlengis osensis*, with its three bands of scales, approximates most closely the hypothetical, completely scaled, ancestral type. The differences that have occurred in the squamation of the other two species have been loss variations of a type that may occur readily and are of comparatively minor importance. Indeed, in the course of extensive studies on the Cottidae, I have found several instances where such loss variations result in striking reductions of scaled areas with the increase in age of the individual. *Orthonopias triacis* Starks and Mann and *Clinocottus analis* (Girard) present excellent examples.

In spite of the marked differences in squamation, the many similarities of the three species point to their rather close relationship and indicate that they form a circumscribed evolutionary line comparable in all respects to such genera as *Icelus*, *Myoxocephalus*, and *Gymnocanthus*. It seems advisable, therefore, to group these three fishes together in the single genus *Stlengis*.

#### Genus STLENGIS Jordan and Starks

*Stlengis* JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 27, p. 236, 1904.

*Schmidtia* JORDAN and STARKS, *ibid.*, p. 237.

*Schmidtina* JORDAN and STARKS, *ibid.*, p. 961.

*Genotype*.—*Stlengis osensis* Jordan and Starks.

*Diagnosis*.—Dorsal and ventral body profiles forming almost straight lines from anterior end of first dorsal (deepest point of body) to caudal peduncle but bulging slightly under each of the median fins.

Head markedly depressed, its width at base of upper preopercular spines much greater than depth at same point. Jaws about equal; maxillary extending to or slightly beyond middle of pupil, its posterior width exceeding that of narrow suborbitals. Anterior nostrils in short tubes; posterior nostrils with borders little if any elevated, difficult to distinguish from mucous pores. Orbit large, its diameter greater than length of snout. Interorbital space flat or slightly convex; top of head gently concave, with a pair of low, rounded, parieto-extrascapular elevations at the posterior border of the shallow depression. Nasal spines sharp, slightly curved, their length equal to a little more than 0.5 posterior width of maxillary. Preopercle armed with 4 spines, the upper one long, extending to or very slightly beyond subopercular margin, with a simple or bifid tip and 3 to 5 recurved barbs along its upper margin; lower preopercular spines simple, about as long as barbs of antlerlike spine; the upper one of these simple spines directed backward, the middle one backward and downward, the lower one downward and forward. A minute spinous point at lower angle of subopercle and another at posterior

angle of interopercle; these spines frequently difficult to see but readily located by touch in alcoholic specimens. No other spines on head. Pores of head well developed; those on suborbitals divided into two almost equally prominent series bordering the suborbital chain dorsally and ventrally; anterior pore of the mandibular series unpaired, opening on the median ventral surface of the symphysis. Gill membranes broadly united, free from isthmus. Branchiostegals 6. Teeth in moderately broad, villiform bands on premaxillaries, dentaries, vomer, and palatines. No slit behind the last gill. Gill rakers in the form of short tubercles.

Origin of first dorsal directly over or very slightly behind dorsal end of gill opening; first two spines with approximate bases. Second dorsal separated from first by a narrow but definite interspace. Origin of anal under first, second, or third dorsal ray. Pectorals extending to perpendicular from first or second anal ray. Pelvic base very slightly behind lower end of pectoral base; fin of 1 spine and 2 rays, the inner one the longer. Caudal slightly rounded. Anus in front of anal origin at a distance about equal to diameter of pupil, located just anterior to a very small, bluntly conical, genital papilla. Sides of body with 1, 2, or 3 longitudinal bands of large ctenoid scales, each band only one scale in width. No cirri present.

*Remarks.*—It is difficult to estimate the exact degree of relationship of the three fishes comprising this genus. However, the fact that *Stlengis misakia* has progressed farthest in the reduction of scales, and that in this species the pores of the lateral line system on the head have remained small and those of the mandibular series become encircled by small supernumerary openings, while in the other two species they have become markedly enlarged and remained simple, indicates that *S. misakia* is the most isolated form. While this species was probably the first to split from the ancestral stock, the pronounced differences occurring in the other two species suggest that they were derived from a branching of the primitive line soon after the splitting off of *S. misakia*.

The preopercular armature, the ventral fins, and the structure of the scales indicate that this genus is most closely related to *Icelinus* Jordan, of the western coast of North America.

#### KEY TO THE KNOWN SPECIES OF THE GENUS *STLENGIS*

- $\alpha^1$ . Sides of body armed with a single band of scales; main pores of mandibular series surrounded by small supernumerary openings-----*misakia*
- $\alpha^2$ . Sides of body armed with 2 or 3 bands of scales; pores of mandibular series simple.
  - $\beta^1$ . Sides of body with 2 bands of scales; anal fin with 10 or 11 rays-----*distoechus*
  - $\beta^2$ . Sides of body with 3 bands of scales; anal fin with 14 rays-----*osensis*



## STLENGIS OSENSIS Jordan and Starks

*Stlengis osensis* JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 27, p. 236, fig. 1, 1904; Bull. U. S. Fish Comm., vol. 22, p. 590, fig., 1902 (1904).—JORDAN, TANAKA, and SNYDER, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 33, p. 255, fig. 189, 1913.

*Diagnosis*.—Orbit 3.0 in head. Pores of head large and prominent, those of mandibular series simple. Dorsal VIII, 15; anal 14; pectorals 20. Sides of body with 3 longitudinal bands of strongly ctenoid scales; the dorsal band extends from level of sixth dorsal spine to caudal base and contains 27 scales; the middle band, following the lateral line, extends to just beyond end of second dorsal and contains 27 scales; the ventral band extends from just anterior to anal origin to caudal base and contains 24 to 25 scales.

Unfortunately the values given in the type description for the fin ray and scale counts are in error. The figure is correct with regard to these structures.

STLENGIS DISTOECHUS,<sup>1</sup> new species

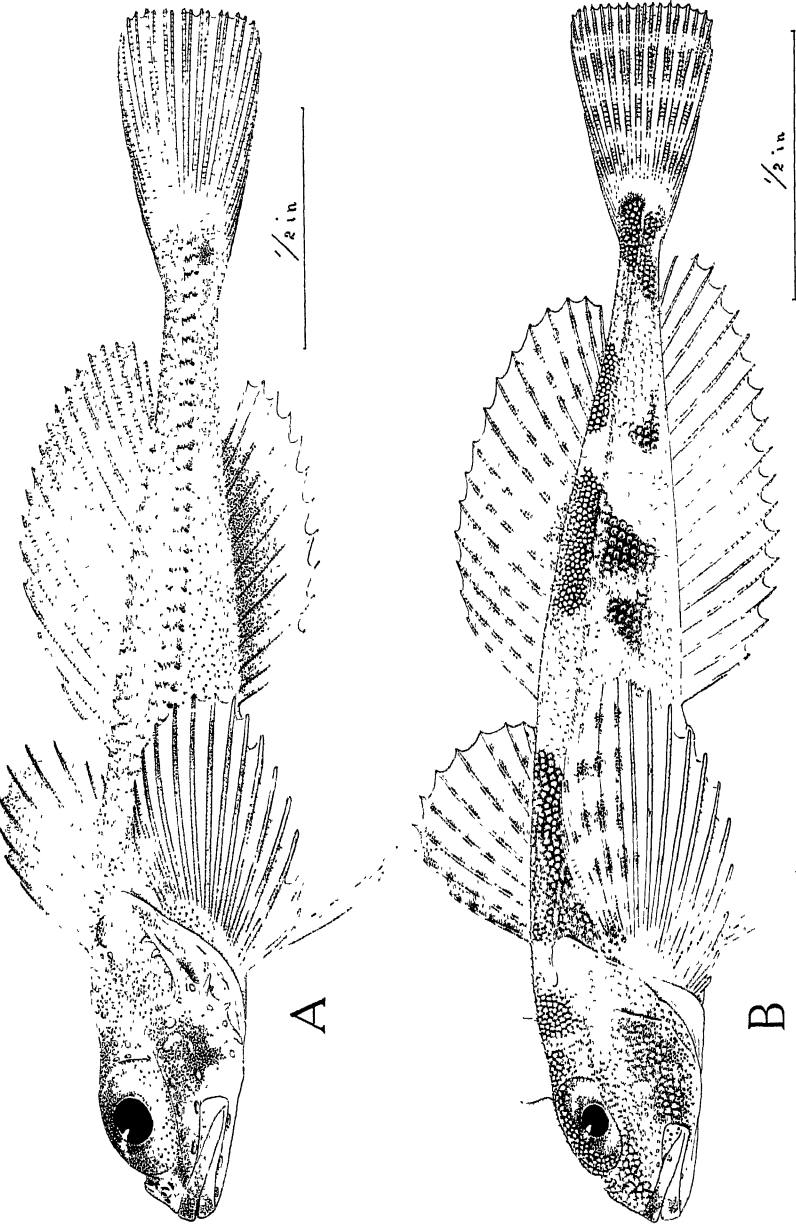
## FIGURE 26; PLATE 34, A

*Diagnosis*.—Orbit 2.6 (2.5–2.6) in head. Pores of head large and prominent, those of mandibular series simple. Dorsal VIII (VIII–IX), 16 (16–17); anal 11 (10–11); pectorals 17 (16–18). Sides of body with 2 bands of ctenoid scales; the dorsal band extends from level of fifth or sixth dorsal spine to near base of upper caudal rays and contains 26 (23–28) scales; the band along lateral line extends to caudal base and contains 36 (34–37) scales.

Body slightly depressed anteriorly, slightly compressed posteriorly; distance from origin of first dorsal to pelvic base 2.1 (2.0–2.1) in head; width at upper end of pectoral base 2.0 (1.9–2.0) in head. Least depth of caudal peduncle 2.3 (2.2–2.4) in orbit.

Head 2.9 (2.8–2.9) in standard length; snout short, 2.0 (1.9–2.1) in orbit, forming an angle of 133° (129°–139°) with frontoparietal region, of 67° (60°–72°) with chin. Maxillary extending slightly beyond middle of pupil. Eye large, diameter of orbit 2.6 (2.5–2.6) in head. Interorbital width about equal to width of suborbitals. Upper preopercular spine with a simple or bifid tip and 3 or 4 recurved barbs along its upper margin. The variation in the tip of the spine, together with the well-known facts of spine development in other genera, leaves no doubt that the number of barbs is a function of age. The three lower preopercular spines are all simple except in one specimen, where the middle one is narrowly bifid on both sides. Pores of head large, 3 prominent ones along dorsal border of suborbitals between anterior margin of orbit and base of suborbital stay; pores of mandibular series simple, without circlet of supernumerary openings.

<sup>1</sup> From *Stenoxos*, two-rowed.



A, *Silengis distochus*, new species; B, *Astrocutus leprops*, new genus and species.



Base of first dorsal 2.3 (2.0–2.5) in head; fin of 8 (8–9) spines; first spine 1.5 (1.3–1.7) in fourth or fifth spine, which is longest, being 2.6 (2.3–3.0) in head. Base of second dorsal 1.1 (1.0–1.1) in head; fin of 16 (16–17) rays; first ray 1.9 (1.5–2.3) in sixth ray, which is longest, being 2.0 (1.9–2.1) in head. Anal origin under second or third dorsal ray, its posterior end under fourth ray from end of second dorsal; base of fin 1.5 (1.4–1.6) in head; fin of 11 (10–12) rays; first ray 1.8 (1.6–1.9) in sixth or seventh ray, which is longest, being 2.8 (2.6–2.9) in head. Pectoral base 3.1 (3.0–3.3) in head; fin of 17 (16–18) rays; longest ray 1.4 (1.4–1.5) in head. Pelvics extending to or slightly beyond anus, their length 1.7 (1.7–1.9) in head. Caudal with 8 (8–9) split rays; length of fin 1.4 (1.3–1.4) in head.

A single series of 26 (23–28) large scales forming a band along base of dorsal fins, having its origin under fifth or sixth dorsal spine and extending on the dorsal surface of the caudal peduncle to or almost to base of upper caudal rays. Each of these scales in the form of a roughly oval, deeply embedded plate from which rises another smaller strongly ctenoid plate inclined posteriorly. Lateral line armed with 36 (34–37) deeply embedded scales in the form of short tubes, their free posterior margins strongly ctenoid.

TABLE 1.—*Measurements of Stlengis distoechus*

Measurement	Percent of standard length
Origin of first dorsal to pelvic base.....	17.2 (16.7–17.5)
Origin of second dorsal to anal origin.....	13.6 (13.1–14.6)
Least depth of caudal peduncle.....	5.8 (5.5–6.0)
Distance between dorsal ends of pectorals.....	18.0 (17.6–18.3)
Head (snout to tip of subopercular flap).....	35.2 (34.6–36.3)
Diameter of orbit.....	13.6 (13.1–14.2)
Snout (tip of premaxillaries to edge of orbit).....	6.7 (6.3–7.2)
Maxillary (from median line just above upper lip).....	13.4 (12.9–14.0)
Snout to origin of first dorsal.....	31.7 (30.4–32.6)
Base of first dorsal (from first to last spine).....	15.3 (13.8–17.2)
Snout to origin of second dorsal.....	50.5 (49.8–51.5)
Base of second dorsal.....	33.5 (32.7–34.3)
Snout to anal origin.....	52.5 (51.1–53.8)
Base of anal.....	24.2 (22.0–25.8)
Snout to dorsal end of pectoral base.....	34.6 (33.5–35.5)
Snout to ventral end of pectoral base.....	26.6 (26.0–27.4)
Width of pectoral base.....	11.3 (11.1–11.8)
Length of pectoral (longest ray).....	24.4 (23.8–25.6)
Snout to pelvic base.....	26.9 (26.6–27.5)
Length of pelvics.....	20.4 (19.0–21.6)
Length of caudal.....	25.4 (24.8–27.0)
Snout to anus.....	47.0 (46.4–48.0)

The color of all the specimens has bleached out during their quarter of a century in alcohol to a pale brownish yellow. The dorsal, anal, and pectoral fins show faint indications of darker markings, while the pelvics and lower rays of the pectorals seem to have been silvery white.

*Holotype*.—U.S.N.M. no. 94728, 52 mm in standard length, 65 mm in total length; from *Albatross* station 4968, off the coast of Wakayama, Japan, lat.  $33^{\circ}24'50''$  N., long.  $135^{\circ}38'40''$  E., in 253 fathoms.

*Paratypes*.—U.S.N.M. no. 94729, 3 specimens, 48.5–51.5 mm in standard length; from the same station. Nat. Hist. Mus. Stanford Univ. no. 28727, 1 specimen, 50.5 mm in standard length; from the same station.

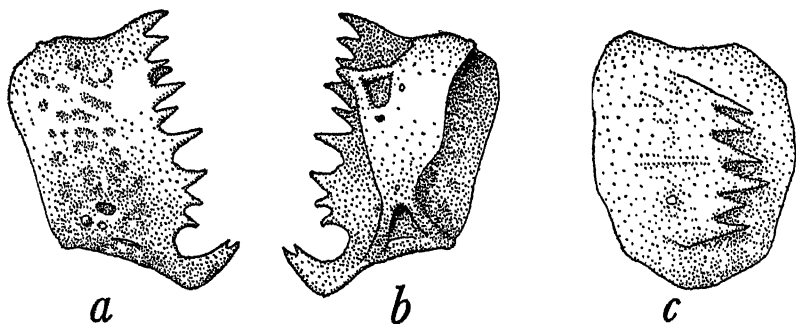


FIGURE 26.—*Stlengis distoechus*, new species: a, External, and b, internal view of lateral line scale; c, scale from dorsal band.

#### STLENGIS MISAKIA (Jordan and Starks)

*Schmidtia misakia* JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 27, p. 237, fig. 2, 1904.

*Schmidtina misakia* JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 27, p. 961, 1904; Bull. U. S. Fish Comm., vol. 22, p. 590, fig., 1902 (1904).—JORDAN, TANAKA, and SNYDER, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 33, p. 255, fig. 190, 1913.

*Diagnosis*.—Orbit 3.1 (3.0–3.4) in head. Pores of head moderate in size; the main ones of the mandibular series surrounded by a circlet of small supernumerary openings. Dorsal IX (IX–XI), 16 (15–17); Anal 13 (12–14); Pectoral 17 (15–18). Lateral line armed with 36 (36–37) scales, the scale band extending to base of caudal fin. No other scales present.

#### ASTROCOTTUS,<sup>3</sup> new genus

*Genotype*.—*Astrocottus leprops*, new species.

*Diagnosis*.—Preopercle armed with 3 short simple spines. Gill membranes broadly united, free from isthmus. Branchiostegals 6. Teeth in broad villiform bands on premaxillaries, dentaries, and

<sup>3</sup> From *αστρον*, constellation + *Cottus*.

vomer; none on palatines. No slit behind last gill. Gill rakers in form of short tubercles. Anal fin longer than second dorsal; pelvics I, 3. Head and body almost completely covered with strongly ctenoid scales.

This monotypic genus appears to be quite isolated. In some respects it resembles *Ricuzenius* Jordan and Starks, in others *Stelgistrum* Jordan and Starks; but in each case the relationship is remote.

**ASTROCOTTUS LEPROPS,<sup>4</sup> new species**

**FIGURE 27; PLATE 34, B**

*Diagnosis.*—Body depressed throughout, deepest at base of pelvics, the distance from origin of first dorsal to pelvic base 1.9 in head, width at dorsal end of pectoral base 1.6 in head. Ventral body contour practically straight, dorsal contour forming an even gently convex

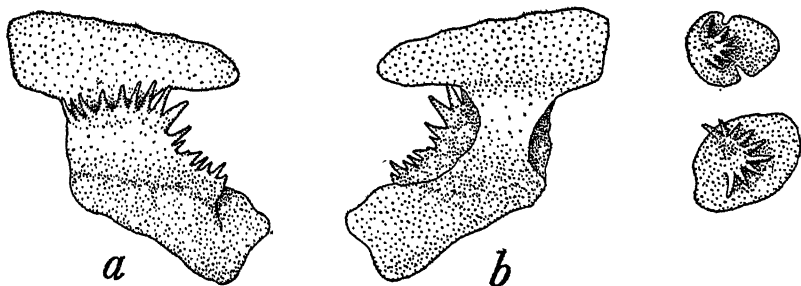


FIGURE 27.—*Astrocottus leprops*, new genus, new species: *a*, External, and *b*, internal view of lateral line scale; *c*, scales from dorsal part of body.

curve from deepest point to very slender caudal peduncle, the least depth of which is 2.7 in orbit.

Head 3.3 in standard length; snout 1.2 in orbit, moderately steep, forming an angle of about 65° with chin. Lower jaw slightly shorter than upper, barely included; maxillary reaching slightly beyond anterior margin of pupil. Anterior and posterior nostrils both in short heavy tubes about equal in length to nasal spines. Size of eye moderate, diameter of orbit 3.2 in head. Suborbital width moderate, 3.0 in orbit. Interorbital space flat, narrow, about 2.0 in posterior width of maxillary. Top of head gently concave. Nasal spines small, their length equal to 0.5 interorbital space. Three simple preopercular spines, all very short; the upper one slightly curved upward; the middle one broad and triangular; the lower one a simple obtuse expansion of the preopercular border. No other spines on head. Pores of head inconspicuous; those of suborbital series in a fairly definite row along the ventral margin, with small supernumerary pores just above; a wide band of numerous small pores on preopercle

<sup>4</sup> From λεπρός, scaly + ὤψ, face.

with a large pore on the margin below each spine; mandibular series made up of groups of small irregularly placed pores; the anterior one on the median line of the symphysis large, simple, and unpaired.

Origin of first dorsal very slightly behind a perpendicular from the posterior end of subopercle ("opercular flap"); base of fin 1.6 in head; fin of 10 spines, the first two with approximate bases; first spine 1.8 in fourth spine, which is longest, being 2.2 in head.<sup>5</sup> Second dorsal separated from first by an interspace about equal to diameter of pupil; its posterior end over base of third ray from end of anal; base of fin 3.0 in standard length; fin of 15 rays; first ray 1.2 in fifth ray, which is longest, being 2.2 in head. Origin of anal about under origin of second dorsal, base of fin 2.7 in standard length; fin of 17 rays; first ray 1.2 in middle rays, the fourth to thirteenth rays subequal and longest, being 2.9 in head. Pectoral base 2.7 in head; fin of 20 rays; longest ray 1.1 in head, extending to level of third anal ray. Base of pelvis behind lower end of pectoral base at a distance about equal to diameter of pupil; middle ray longest, outer ray shortest; length of fin 2.6 in head, extending about 0.5 distance to anal origin. Caudal truncate; with 9 split rays; its length 1.4 in head. Anus in front of anal origin at a distance 1.5 in diameter of orbit; located just anterior to the base of a short, heavy, bluntly conical genital papilla, which is depressed in an abrupt pit extending 0.5 distance to anal origin.

Head and body almost completely scaled; many small scales occurring on anterior, dorsal, and posterior portions of eyeball. Small naked areas surround the anterior nostrils, others occur between nasal spines and posterior nostrils. Lips, chin, lower half of suborbitals, interopercle, lower portion of preopercle and subopercle, and branchiostegal membranes naked. A narrow naked strip surrounds the dorsal fins and extends along the dorsal surface of the caudal peduncle. A similar naked strip occurs ventrally, extending from just anterior to pelvic base to base of caudal fin. The portion of the body below the lateral line, which is covered by the pectoral fins, is naked; this area is separated from the ventral one by a narrow band of scales. The general body scales are in the form of more or less oval, deeply embedded plates from which arise V-shaped or semicircular ctenoid ridges inclined posteriorly. The scales above the lateral line are very irregular in size and position. Below the lateral line the arrangement is more regular, with a tendency toward imbricated rows, larger scales occurring near the lateral line, smaller ones ventrally. Lateral line armed with 34 large scales, each in the form of a short tube with large dorsal and ventroposterior expansions, the outer arch of the tube with a strongly ctenoid dorsal ridge and posterior margin. A long

<sup>5</sup> Additional specimens of this species, recently discovered in the unworked collections of Stanford University, show that the first two dorsal spines are entirely detached from the rest of the fin. Both the artist and I had mistaken the lack of membrane between the second and third spines of the type specimen for a tear in the fin. The membrane between these spines is, however, normally absent, and the figure errs in this respect.

slender cirrus, its length about equal to diameter of pupil, at upper posterior margin of each orbit; a pair of similar cirri on top of head in line with the supraorbital cirri and just anterior to dorsal end of gill opening.

TABLE 2.—*Measurements of the holotype of Astrocottus leprops*

Measurement	Mm
Standard length.....	48.0
Total length.....	58.4
Origin of first dorsal to pelvic base.....	7.7
Origin of second dorsal to anal origin.....	6.4
Least depth of caudal peduncle.....	1.9
Distance between dorsal ends of pectoral bases.....	9.0
Head.....	14.6
Diameter of orbit.....	4.6
Snout.....	4.0
Maxillary.....	5.2
Snout to origin of first dorsal.....	14.8
Base of first dorsal.....	9.4
Snout to origin of second dorsal.....	25.5
Base of second dorsal.....	16.5
Snout to anal origin.....	24.5
Base of anal.....	17.9
Snout to dorsal end of pectoral base.....	13.9
Snout to ventral end of pectoral base.....	9.9
Width of pectoral base.....	5.5
Length of pectoral.....	13.5
Snout to pelvic base.....	13.0
Length of pelvics.....	5.7
Length of caudal.....	10.4
Snout to anus.....	21.0

General body color in alcohol, brownish yellow. A broad reddish-brown bar extends downward and backward from eye. A patch of similar color on top of head, traversed by a narrow whitish cross band, which gives off a short median extension anteriorly. Back crossed by 4 wide reddish-brown cross bars; the first one, under the posterior half of first dorsal, extending downward and forward toward axilla; the second one, under middle of second dorsal, bordered dorsally by whitish anteriorly and posteriorly, extending to halfway between lateral line and anal; third bar, under posterior part of second dorsal, interrupted at lateral line, extending to near anal; fourth bar covering posterior half of caudal peduncle. There is a slight indication of an additional bar under the anterior end of first dorsal; only its posterior margin can be made out, the bar fading



into the general ground color anteriorly. Belly silvery. Dorsals and caudal faintly barred with pale, reddish brown. A brownish patch on base of upper pectoral rays, which are coarsely barred with pale brown, a silvery spot on base of middle rays, and streaks of white on lower rays. Pelvics and anal colorless.

*Holotype*.—U.S.N.M. no. 94730; from *Albatross* station 4808, Tsugaru Strait, Japan, lat.  $41^{\circ}35'50''$  N., long.  $140^{\circ}36'45''$  E., in 47 fathoms. This is the only specimen known.

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## TERTIARY PLANTS FROM VENEZUELA

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IN 1920 and 1921 I published brief papers on Tertiary Venezuelan plants<sup>1</sup> that had been collected by Charles F. Bowen in 1919. Subsequently I received collections from the same and additional localities made by Harold F. Crooks and R. A. Liddle in 1921, by Dr. L. W. Stephenson and Dr. James A. Tong in 1923 and 1925, and by H. G. Kugler in 1925. These received preliminary study and were reported upon at the time, but no mention of them has appeared in print. Although they do not add greatly to the Tertiary floras of Venezuela, they include a number of new and interesting forms, and since large or well-preserved collections of fossil plants from this region are not apt to be accessible in the near future, it is important that the known occurrences be available as an aid in solving the problems of correlation in this and other regions in northern South America and the Antilles.

In the present paper fossil plants are discussed from localities as follows:

### EOCENE

In 1920 I described a remarkable fruit of *Entada*—the sea-bean—from dark shales. This was collected by C. F. Bowen at Mesa Pablo about 8 kilometers southwest of Escuque, State of Trujillo. Beds of similar age in the District of Sucre, State of Zulia, contain leaves

<sup>1</sup> Berry, E. W., Amer. Journ. Sci., vol. 50, pp. 310-312, fig. 1, 1920; Proc. U. S. Nat. Mus., vol. 50, pp. 553-579, 4 figs., 3 pls., 1921.

of several species of terrestrial plants preserved in a soft reddish sandstone. These are described herein; they were collected by Drs. L. W. Stephenson and J. A. Tong.

### MIOCENE

#### LOCALITY 1: PALMAREJO

This locality is in the District of Mara, State of Zulia. It is on the west side of the lake, 20 kilometers north of the city of Maracaibo, the exposures being in the lake cliffs. The matrix is a somewhat sandy laminated clay. The collectors were H. F. Crooks and R. A. Liddle. The age of the plants is Miocene and is perhaps slightly younger than the others.

#### LOCALITY 2: ZAPAYARI-EL PLAN ROAD

About  $1\frac{1}{2}$  kilometers south of Rio Grande, District of Bolivar, State of Zulia. Yellowish to red soft argillaceous fine-grained sandstone, often highly ferruginous. Collected by Dr. L. W. Stephenson, Dr. J. A. Tong, and W. D. Miller, December 5, 1923.

#### LOCALITY 3: RIO PALO NEGRO

North of Hato Venado, District of Bolivar, State of Zulia. Gritty yellowish sandstone. Collected by Dr. L. W. Stephenson, Dr. J. A. Tong, and W. D. Miller, December 3, 1923.

#### LOCALITIES 4 AND 5: LA VICTORIA

This covers two localities in the District of Miranda, State of Zulia, both in a yellowish to reddish sandstone matrix. One on the La Victoria-Catanaja Road, about  $2\frac{1}{2}$  kilometers north of La Victoria (locality 4), and the other  $3\frac{1}{2}$  kilometers south of La Victoria and half a kilometer southwest of El Rudal ranch house (locality 5). The age indicated is lower or middle Miocene. The collectors were Drs. L. W. Stephenson and J. A. Tong.

#### LOCALITY 6: EL MENE

This is in the District of Acosta, State of Falcon. The exact locality is 2 kilometers northeast of El Mene. The matrix is a slightly brownish, finely sandy, and relatively hard clay. The plant material is abundant and matted in certain thin layers and inclined to be fragmentary and poor. It was collected by H. G. Kugler in 1925. This horizon is said to belong to the sandy part of the lower Salada series of Wiedenmayer's paper of 1924 and is considered by Liddle (1928) a part of the Cerro Pelado formation and lower Miocene in age.

## LOCALITY 7: BETIJOQUE

This is in the District of Betijoque, State of Trujillo. The exact locality is 100 meters east of the Sabana de Mendoza Road in the northern outskirts of the town and about 600 meters north 2° east of the main church steeple in Betijoque. The matrix is a soft light-colored clay, and the plants are on the whole well preserved. Nine species collected by Bowen were described from here in the 1921 paper, and the present contribution adds about as many more. There has been some difference of opinion regarding the age, but so far as I know it has not appeared in print, and there cannot be the slightest doubt that the plant horizon is lower or middle Miocene in age.

## LOCALITY 8: LA SALVADORA

This locality is along the trail 4 kilometers northwest of La Salvadora and between 40 and 48 kilometers south of Betijoque in the State of Trujillo. The matrix is a yellowish sandy micaceous clay from which seven species were described in 1921 and is of approximately the same age as the preceding.

Of these eight localities in Venezuela from which determinable fossil plants of Miocene age have been collected, one is in the State of Falcon, two in Trujillo, and five in Zulia. None has yielded a prolific flora, the number of species varying from 2 at Rio Palo Negro and south of La Victoria to 12 at La Salvadora and 18 at Betijoque. The last is not only the most prolific but also represents the best preservation, and more extensive and careful collecting probably would at least triple the number of forms recognized.

Because the present collections do not represent a greater number of forms and so can not be considered a reasonable sampling, it is impossible to deduce any reliable ecologic considerations or to institute any adequate comparisons between localities. The only ferns recognized comprise two species, and these both come from Betijoque and have not been collected at any of the other Venezuelan localities, although one of these was first described from the Cauca Valley in Colombia.

The total number of species from the Miocene of Venezuela recorded herein is 40, and some of these are based on scanty and fragmentary material. Twenty-one, or more than half, of these have not been found outside of Venezuela. Of these 21 only the following are confined to a single locality in Venezuela:

SPECIES	LOCALITY
<i>Achras calcicicola</i> .....	4
<i>Antholithus venezuelensis</i> .....	8
<i>Bignonia zuliana</i> .....	4
<i>Blechnum betijoquensis</i> .....	7
<i>Burserites venezuelana</i> .....	8
<i>Leguminosites entadaformis</i> .....	8
<i>Leguminosites venezuelensis</i> .....	8
Leguminous pod.....	2
<i>Pleonotoma miocenica</i> .....	7
<i>Poacites</i> sp.....	4
<i>Rhizophora boweni</i> .....	7
<i>Simaruba miocenica</i> .....	7
<i>Sophora salvadorana</i> .....	8
<i>Zamia</i> (?) sp.....	7

Of these 14 forms, several—such as the flower *Antholithus*, the fern *Blechnum*, the grass fragment *Poacites*, the leguminous leaflets *Leguminosites* and *Sophora* and pod, and the supposed fragment of a cycad pinnule (*Zamia*)—are the sort of things dependent for their presence as fossils largely on accidents of preservation, and therefore they are of slight value in questions of composition, ecology, or age.

The following 21 species, or half the total number known from the Miocene of Venezuela, are not known from other regions:

SPECIES	LOCALITY
<i>Achras calcicicola</i> .....	4
<i>Anona sphaerocarpoides</i> .....	2, 7
<i>Antholithus venezuelensis</i> .....	8
<i>Apocynophyllum salvadorensis</i> .....	1, 6, 8
<i>Bignonia zuliana</i> .....	4
<i>Blechnum betijoquensis</i> .....	7
<i>Burserites venezuelana</i> .....	8
<i>Chrysobalanus venezuelanus</i> .....	6, 7
<i>Combretum stephensoni</i> .....	4, 5
<i>Inga</i> sp.....	1, 6
<i>Leguminosites entadaformis</i> .....	8
<i>Leguminosites venezuelensis</i> .....	8
Leguminous pod.....	2
<i>Persea</i> sp.....	1, 4
<i>Pleonotoma miocenica</i> .....	7
<i>Poacites</i> sp.....	4
<i>Rhizophora boweni</i> .....	7
<i>Simaruba miocenica</i> .....	7
<i>Sophora marana</i> .....	1, 6, 7
<i>Sophora salvadorana</i> .....	8
<i>Zamia</i> (?) sp.....	7

Some of these, as the *Inga*, *Persea*, *Poacites*, and *Zamia* (?), are of slight significance because of incompleteness, and the first three represent widespread types.

Twenty-three of the 40 species recorded from the Miocene of Venezuela have been found at but a single Venezuelan locality, al-

though 10 of these are known from localities in adjoining regions. Those from a single locality are distributed as follows: 1 each at localities 1 and 2; 2 at locality 6; 4 at locality 4; 10 at locality 7; and 5 at locality 8. The large number at locality 7 is due in part to the larger total of species from there and to the presence of rare things like the flower and small leaflets, which are in part due to the finer matrix. Five of those recorded from this locality have an outside distribution. Eleven are recorded from two Venezuelan localities, and six of these have an outside distribution. Four are known from three Venezuelan localities, and two of these have an outside distribution. One is recorded from four Venezuelan localities, and this is found also in Colombia and northwestern Peru. Two species are present at five Venezuelan localities; one of these, *Anona guppyi*, is also present in Colombia, and the other, *Trigonia varians*, is present also in Colombia and Peru.

There seems to be no question but that these Venezuelan floras are of Miocene age. Whether they are lower Miocene, as Dr. L. S. Stephenson and others believe, or whether they are slightly younger and possibly middle Miocene, as I have been inclined to think, or whether all eight localities are of the same or different ages is impossible to determine with the present material.

A glance at the accompanying table of distribution (table 1) shows that only 14 of the 40 species have been found at but a single locality. The other 26 occur at two or more Venezuelan localities, and 19 of them at localities outside of Venezuela. The details are given in the table, but a summary may be useful:

Eleven species are recorded from locality 1, and seven of these are known from Trinidad, Colombia, Central America, Ecuador, Peru, or Puerto Rico. Six species are recorded from locality 2, and four of these are known from Colombia, Central America, Ecuador, or Peru. Two species are recorded from locality 3, and both are known from Colombia and one from Peru. Nine species are recorded from locality 4, and three of these are known from Colombia and a fourth from Trinidad. Two species are recorded from locality 5, and one of these occurs in Colombia and the other at four Venezuelan localities. Twelve species are recorded from locality 6, and eight are known from Colombia, Ecuador, Trinidad, Peru, or Puerto Rico. Eighteen species are recorded from locality 7, and 11 of these are known from Central America, Colombia, Ecuador, Peru, or Puerto Rico. Seven species are recorded from locality 8, of which five are peculiar to this region, one is also from localities 1 and 6, and one occurs in Colombia and northwestern Peru.

Locality 8, therefore, is the only one in Venezuela that might be of different age from the other seven. My impression is, and in the absence of more data it can not be considered other than such, that

all the localities, although not precisely synchronous, are not very different in age and might range, say, through the lower Miocene (Burdigalian) or through a part of the lower Miocene and into the lower middle Miocene (Helvetian).

TABLE 1.—*Distribution of Miocene plants from Venezuela recorded in this paper*

Species	Venezuela								Colombia				Ecuador	Northwestern Peru	Southern Mexico	Costa Rica	Trinidad, B. W. I.
	Locality								De Mares Concession	Santa Ana	Cauca Valley	Ielva					
	1	2	3	4	5	6	7	8									
<i>Achras calceicollafolia</i> .....				x													
<i>Anona guppyi</i> .....			x	x	x	x	x		?								
<i>Anona sphaerocarpoides</i> .....		x					x										
<i>Anthonothus venezuelensis</i> .....								x									
<i>Apocynophyllum salvador- ensis</i> .....	?					x		x									
<i>Bignonia zuliaana</i> .....				x													
<i>Blechnum betijoquensis</i> .....							x										
<i>Burserites venezuelana</i> .....								x									
<i>Cassia longifolia</i> .....							x						x				x
<i>Cassia zuliaana</i> .....	x					x											x
<i>Chrysobalanus venezue- lanus</i> .....						x	x										
<i>Combretum stephensoni</i> .....				x	x												
<i>Condaminea grandifolia</i> (?).....	x		x							x				x			
<i>Coussapoa ritlosoides</i> .....							x		?								
<i>Ficus betijoquensis</i> .....						x	x		?								
<i>Heliconia elegans</i> .....							x			x							x
<i>Hernandia tongi</i> .....		x		x					x								
<i>Inga reissi</i> .....	x									x		x					
<i>Inga</i> sp.....	x					x											
<i>Leguminosites entadaformis</i> .....								x									
<i>Leguminosites venezuelen- sis</i> .....								x									
<i>Leguminous pod</i> .....		x															
<i>Menisium wofii</i> .....							x				x						
<i>Nectandra areolata</i> .....	x	?								x		x			x	x	
<i>Palmophyslum</i> sp.....	x					x	x		x		x						
<i>Persea coriacea</i> .....						x			x	x		?					
<i>Persea</i> sp.....	x			x													
<i>Piperites cordatus</i> .....							x										
<i>Pleonotoma miocenica</i> .....							x										
<i>Poacites</i> sp.....				x													
<i>Rhizophora boweni</i> .....							x										
<i>Sabicea asperifolia</i> .....		x				x	x				x	?					
<i>Simaruba miocenica</i> .....						x	x										
<i>Sophora marana</i> .....	x					x	x										
<i>Sophora salvadorana</i> .....								x									
<i>Styrax lanceolata</i> .....						x				x							
<i>Tapirira lanceolata</i> .....	x	x				x							x	x			
<i>Tapirira trinitiana</i> .....				x													x
<i>Triponia varians</i> .....	x			x		?	x	x	x	x				x			
<i>Zamia</i> (?) sp.....							x										

## THE EOCENE PLANTS

The fossil plants from the Eocene of Venezuela, aside from the seed of *Entada* already mentioned, come from two outcrops close together about three-fourths of a kilometer south of Santa Barbara and 2½ kilometers east of Los Barrosos, District of Sucre, State of Zulia. In addition to undeterminable species of leguminous leaflets, a fan palm, a small lauraceous leaf, and a *Eugenia*, the following have been identified:

*Apocynophyllum* cf. *texensis* Berry.

*Burserites fayetteensis* Berry (?)

*Cedrela jacksoniana* Berry (fig. 28, b).

*Chrysophyllum preoliviforme* Berry (?).

*Ficus americanafolia*, new species (fig. 28, a).

With the exception of the last, which is new, these are late Claiborne or Jackson species in southeastern North America and appear to indicate an upper Eocene age, probably corresponding with lower Jackson.

This Eocene florule is much more like that of North America than is the case with the Miocene flora of Venezuela. The obvious explanation is that in the upper Eocene there was a considerable extension of more equable and warmer climate north of the equatorial zone.

**FICUS AMERICANAFOLIA, new species**

FIGURE 28, a

This is based upon the single specimen figured, but this shows the complete leaf and lacks only the petiole. It is named from its great resemblance to the existing *Ficus americana* Aublet. Whether this specimen is typical of the botanical species represented cannot be determined from a single specimen. With this limitation it may be described as follows:

Leaves small, lanceolate or slightly ovate-lanceolate in outline. Apex somewhat more acute than base. Length about 8 cm. Maximum width about 2.25 cm. Texture coriaceous.

Petiole missing, obviously stout, presumably short. Mid vein stout and straight, prominent on under side of leaf. Secondaries numerous, rather thin, prominent on under side of leaf. There are about 15 pairs, opposite to alternate, more widely spaced and subtending a smaller angle in upper part of leaf; they diverge from the mid vein at angles of 55° to 70°, are relatively straight and subparallel, and are abruptly camptodrome in marginal region. The tertiary venation is obscured by the coarseness of the matrix; a few intermediate, rather thin veins can be seen diverging from the mid vein, subparallel with secondaries, and these appear to show



ficoid connections with secondaries, but these are not clear, probably because it is the upper surface of the leaf that is exposed.

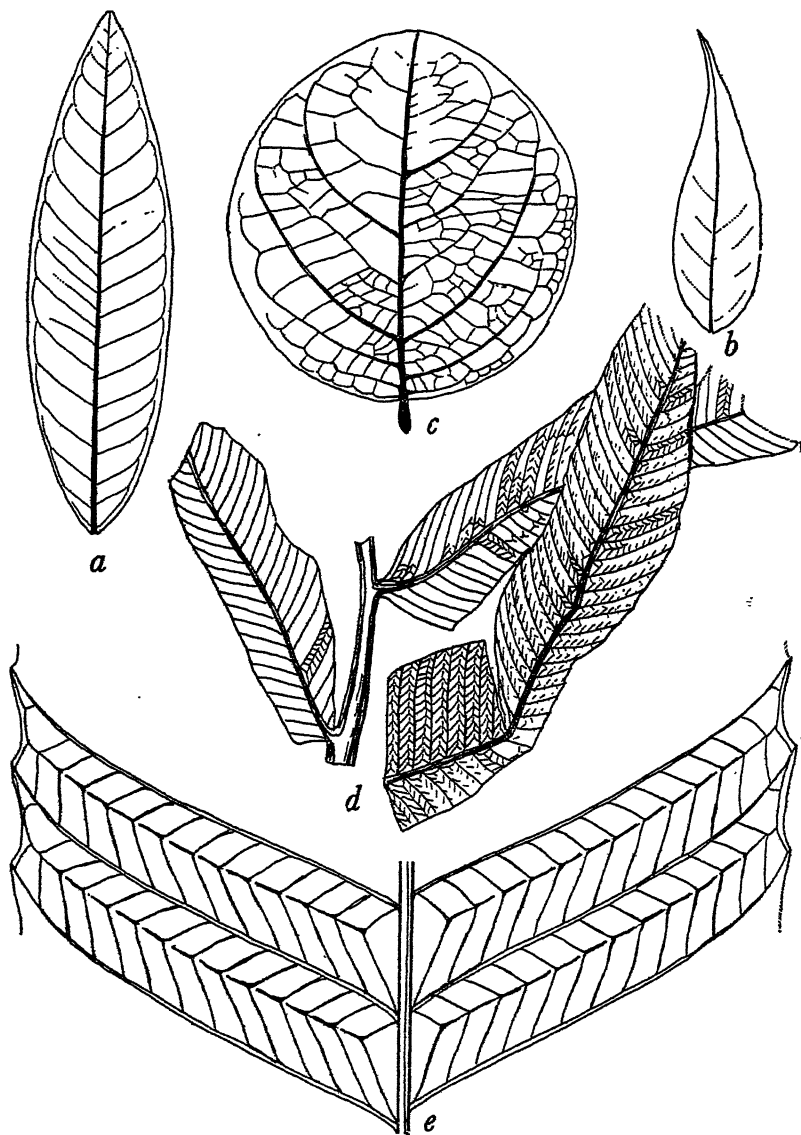


FIGURE 28.—a, *Ficus americanafolia*, new species (near Santa Barbara); b, *Cedrela jacksoniana* Berry (near Santa Barbara); c, *Chrysobalanus venezuelanus*, new species (Betijoque); d, *Meniscium wolff* Engelhardt (Betijoque); e, same enlarged to show venation. Others about three-fourths natural size.

Among previously described fossil species the present form shows similarities to *Ficus laqueata* Engelhardt from Santa Ana, Colombia, which is a much younger form; and to *F. pseudomediafolia* Berry

and *F. wilcoxensis* Berry from the lower Eocene of southeastern North America. It is also much like *F. jynæ* Unger from the Oligocene of the Tyrol in Europe.

Among recent species, as already stated, it is much like *F. americana* Aublet from equatorial America. It is also similar to the leaves of *Pseudolmedia* Trecul, a Caribbean genus of Moraceae.

*Type*.—Upper Eocene: About three-fourths of a kilometer south of Santa Barbara and  $2\frac{1}{2}$  kilometers east of Los Barrosos, District of Sucre, State of Zulia. U.S.N.M. no. 39282.

#### THE MIOCENE PLANTS

### Phylum PTERIDOPHYTA

#### Order POLYPODIALES

#### Family POLYPODIACEAE

#### Genus MENISCIUM Schreber

#### MENISCIUM WOLFI Engelhardt

FIGURE 28, *d*, *e*

*Meniscium wolfi* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 38, pl. 8, figs. 12–17, 1895.

This handsome species was described from the Cauca Valley, Colombia, by Engelhardt, who compared it with the living *Meniscium reticulatum* Swartz, a form that ranges from Jamaica to Peru and Brazil. After comparison with a large quantity of recent material, I am satisfied that Engelhardt's comparison is as good as any that could be made, although I find *M. palustre* Raddi to be equally close. The latter ranges from Central America through northern South America to Brazil.

There is considerable fossil material from Betijoque, and the accompanying enlarged sketch (fig. 28, *e*) shows clearly the venation and also the shallow marginal sinuses between the denticulations that mark the endings of the lateral veins.

The genus *Meniscium* is confined to the American Tropics. Systematic students of modern ferns usually follow Christensen's admirable monograph<sup>2</sup> in considering it a subgenus of *Dryopteris*. For geological purposes, where dependence has to be placed on form and venation, it is preferable to give generic rank to several of these subgenera, such as *Lastrea*, *Goniopteris*, and *Meniscium*, since they go back certainly to the dawn of the Tertiary and contain a large number of forms and are not a compact or closely enough related series either biologically or geographically to fall within

<sup>2</sup> Christensen, Carl, Saertryk af. Biol. Arbej. tilegnede Eug. Warming, 1911.

the limits of a single generic concept. Witness Diel's impossible treatment of them under *Nephrodium* in *Die Pflanzenfamilien*.

*Occurrence*.—Betijoque, District of Betijoque, State of Trujillo. U.S.N.M. no. 39283.

## Phylum CYCADOPHYTA

### Order CYCALES

#### Family CYCADACEAE

##### Genus *Zamia* Linnaeus

###### *Zamia* (?) species

What appears to be a fragment of a pinnule of *Zamia* is found in the collection from Betijoque in the State of Trujillo. The genus has been detected at a number of localities in the American Tertiary in recent years, and although the present specimen is wholly inadequate for purposes of characterization or comparison it probably indicates the presence of this type of plant.

## Phylum ANGIOSPERMOPHYTA

### Class MONOCOTYLEDONAE

#### Order ARECALES

##### Family ARECACEAE

##### Genus *Palmophyllum* Conwentz

###### *Palmophyllum* species

Fragments of palm rays are not uncommon in the Tertiary floras of equatorial America, but they are usually too incomplete for generic determination, as is the case with those found in the Venezuelan Miocene.

*Occurrence*.—Palmarejo, District of Mara, State of Zulia; El Mene, District of Acosta, State of Falcon; Betijoque, District of Betijoque, State of Trujillo.

#### Order POALES

##### Family POACEAE

##### Genus *Poacites* Brongniart

###### *Poacites* species

Fragments of a large grass too incomplete for identification and therefore referred to the form genus *Poacites*, but probably a species

of *Chusquea*, are present at the locality  $2\frac{1}{2}$  kilometers north of La Victoria, District of Miranda, State of Zulia. An undoubted species of *Chusquea* has been described<sup>3</sup> from La Virginia, about 15 kilometers from Girardot, Department of Cundinamarca, Colombia.

## Class DICOTYLEDONAE

### Order PIPERALES

#### Family PIPERACEAE

##### Genus PIPERITES Goeppert

##### PIPERITES CORDATUS Berry

##### FIGURE 29, g

*Piperites cordatus* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 171, pl. 22, fig. 1, 1921; Johns Hopkins Univ. Studies in Geol., no. 6, p. 85, pl. 13, fig. 9, 1925.

This species was described in 1921 from the middle Miocene of southern Costa Rica. Subsequently incomplete material from the Forest sand of the island of Trinidad, British West Indies, was tentatively referred to it.

Recently a somewhat similar form from the Miocene of the De Mares Concession in the State of Santander, Colombia, has been referred to *Dioscorea*. There is some doubt as to whether the present fossil is nearer to *Piper* or to *Dioscorea*, but there is not the slightest doubt of its botanical identity with the type of this species from Costa Rica.

*Occurrence*.—Betijoque, District of Betijoque, State of Trujillo. U.S.N.M. no. 39289.

## Order ANONALES

#### Family ANONACEAE

##### Genus ANONA Linnaeus

##### ANONA GUPPYI Berry

*Anona guppyi* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 567, fig. 3, 1921.

This species was described from the Miocene of Betijoque, Venezuela, in 1921. Later collections have shown it to be present at additional localities in Venezuela and also in beds of approximately the same age on the De Mares Concession in the Magdalena Valley, Department of Santander, Colombia.

<sup>3</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 75, art. 24, p. 2, 1929.

*Occurrence.*—Rio Palo Negro north of Hato Venado, District of Bolivar; about  $3\frac{1}{2}$  kilometers south of La Victoria and half a kilometer southwest of El Ruda! ranch, and La Victoria-Catanaja Road

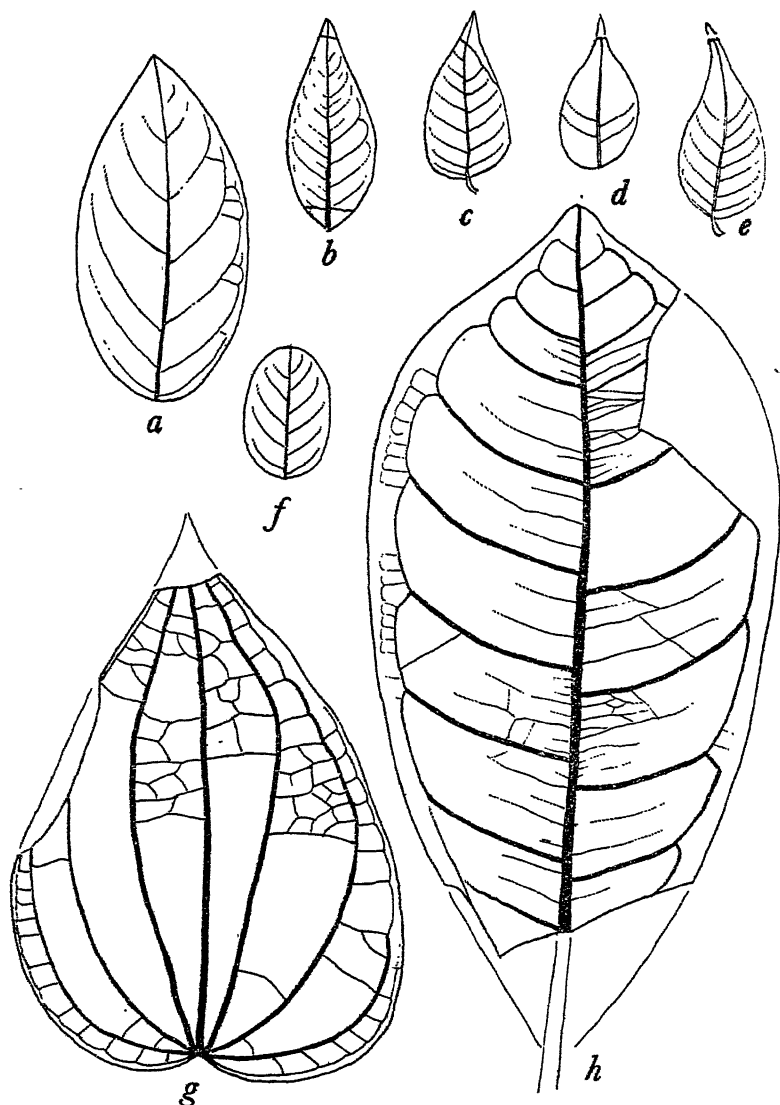


FIGURE 29.—*a*, *Inga reissi* Engelhardt (Palmarejo); *b-e*, *Cassia zuliana*, new species (*b*, Palmarejo; *c-e*, El Mene); *f*, *Sophora marana*, new species (Palmarejo) *g*, *Piperites cordatus* Berry (Betijoque); *h*, *Anona sphaerocarpoides*, new species (Betijoque). All about three-fourths natural size.

about  $2\frac{1}{2}$  kilometers north of La Victoria, District of Miranda, State of Zulia; Betijoque, District of Betijoque, State of Trujillo; El Mene, District of Acosta, State of Falcon.

## ANONA SPHAEROCARPOIDES, new species

FIGURE 29, h

Leaves of medium size, obovate in general outline. Apex narrowing abruptly and incurved, but instead of being acuminate or cuspidate it terminates in a bluntly rounded apiculation. Base cuneate or broadly acute. Margins entire. Texture subcoriaceous. Length about 14 cm. Maximum width, above the middle, about 6.5 cm. Petiole very stout, its length unknown. Mid vein stout, prominent on under side of leaf. Secondaries stout, prominent, about 10, mostly alternate pairs; they diverge from mid vein at angles approaching 90°, are slightly but regularly curved and subparallel, and are abruptly camptodrome well within the margins. Tertiaries thin, forming a transversely elongated mesh within the secondaries and regularly camptodrome arches outside the secondaries along the margins.

This handsome species is known from only fragmentary specimens. Among existing species of this large tropical and subtropical genus, it is much like *A. sphaerocarpa* Splitg, which ranges from Panama through northern South America to Brazil. The fossil is named from its resemblance to this existing species, both having the same form but differing slightly in venation. Another similar existing form with the same tip but otherwise less close is *A. montana* Macfadyen of Puerto Rico.

Still another similar form showing only slight differences in venation is *A. macgravia* Martius, which ranges from Venezuela to about Bahia, Brazil. Among previously described fossils the present species is something like a form from Santa Ana, Colombia, which Engelhardt called *Citharexylon retiforme*. A number of fossil species of *Anona* have leaves of this general type, especially as to venation, but they are either elliptical or broadly lanceolate in form and lack the apical features of *sphaerocarpoides*.

*Occurrence*.—Betijoque, District of Betijoque, State of Trujillo; Zapayari—El Plan Road, 1½ kilometers south of Rio Grande, District of Bolivar, State of Zulia.

*Type*.—U.S.N.M. no. 39295.

## Order ROSALES

## Family ROSACEAE

## Genus CHRYSOBALANUS Linnaeus

## CHRYSOBALANUS VENEZUELANUS, new species

FIGURE 28, c

Leaves of medium size, suborbicular in outline, the apex slightly less full and broadly rounded than base. Margins entire. Texture

subcoriaceous. Length about 6 cm. Maximum width about 5.4 cm. Unfortunately the material is limited to the type specimen, so that nothing can be said of the possible limits of variation of the species.

Petiole stout, somewhat inflated, and about 5 mm in length. Mid vein stout, very prominent on lower surface of leaf, and slightly curved. Secondaries three or four irregularly spaced pairs, stout and prominent; they diverge from mid vein at wide angles, sweep upward in regular curves, and have camptodrome endings. Tertiaries well marked and almost identical with those in the existing *Chrysobalanus icaco* Linnaeus.

*C. icaco* is a small coastal tree ranging from southern Florida to southern Brazil, and its leaves are scarcely distinguishable from those of the fossil species *C. venezuelanus*. Leaves of this type appear in fossil record as early as the lower Eocene in southeastern North America<sup>4</sup>, where they are accompanied by characteristic fruits. Two species have been described from the Pliocene of Bahia, Brazil, and one of these, *C. preicaco*, has been considered ancestral to the living *C. icaco*, fruits of which occur in the Pleistocene of Cuba.

The genus is a small one in the recent flora, confined to the Atlantic coastal regions of the Americas and West Africa. The present Venezuelan species is very similar to the Brazilian fossil species mentioned above, but it is relatively wider and rounder, the latter being almost identical with the leaf of the recent species.

*Occurrence*.—Betijoque, District of Betijoque, State of Trujillo; El Mene, District of Acosta, State of Falcon.

*Type*.—U.S.N.M. no. 39296.

## Family MIMOSACEAE

### Genus INGA Willdenow

#### INGA REISSI Engelhardt

#### FIGURE 29, a

*Inga reissi* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 36, pl. 8, figs. 1, 2; pl. 9, fig. 8, 1895.

This species was described by Engelhardt from Santa Ana, Colombia. Identical material is present in the collections from Palmarejo, Venezuela.

Leaflets sessile or short-petiolulate, variable in size, ovate in general outline, widest at or below middle, inequilateral. Apex acute, sometimes but rarely slightly produced. Base generally broadly rounded. Margins entire, evenly rounded. Texture subcoriaceous. Length 3.25 to 7 cm. Maximum width 1.5 to 3.25 cm. Mid vein stout, generally curved. Secondaries thin, five to seven subopposite to alternate pairs, diverging from mid vein at angles of over 45°,

<sup>4</sup> Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 220, pl. 44, figs. 8-10, 1916.

regularly curved, subparallel, and camptodrome. Tertiaries more or less obsolete.

Although *Inga reissi* resembles the leaflets of various leguminous genera, as for example some species of *Andira*, *Erythrina*, *Pithecolobium*, and *Inga*, it is more entirely similar to the closely related genera *Pithecolobium* and *Inga*, which are abundant in the existing flora of tropical America. In general, *Pithecolobium* has smaller leaflets with less ascending secondaries, whereas a considerable number of modern species of *Inga* are very similar to the fossil. Among these may be mentioned *I. pinetorum* Pittier, *I. tetrephylla* Martius, and *I. flagelliformis* Martius. Engelhardt compared the fossil species with the existing *I. alba*, *I. fagifolia*, and *I. fastuosa*, of Willdenow.

*Occurrence*.—Palmarejo, State of Zulia. U.S.N.M. no. 39297.

#### INGA species

Fragments of what appear to be rather large and inequilateral leaflets of *Inga*, too incomplete for identification, are present at two localities in Venezuela. The genus is common in the Tertiary floras of equatorial America.

*Occurrence*.—Palmarejo, District of Mara, State of Zulia; El Mene, District of Acosta, State of Falcon.

### Family CAESALPINIACEAE

#### Genus CASSIA Linnaeus

#### CASSIA LONGIFOLIA Engelhardt

*Cassia longifolia* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, pp. 19, 24, pl. 2, figs. 14–16, 1895.—BERRY, Johns Hopkins Univ. Studies in Geol., no. 4, p. 123, pl. 5, figs. 2, 3, 1922.

Leaflets sessile, somewhat variable in form and size, relatively small. Apex and base nearly equally rounded, base tending toward cuneate in some specimens and generally more inequilateral than apex. Margins entire. Texture subcoriaceous. Mid vein stout and prominent, usually somewhat curved. Secondaries numerous, closely spaced, relatively stout, and camptodrome. Length 2 to 3 cm. Maximum width 0.75 to 1.1 cm.

This species was described by Engelhardt from the Loja and Tablayacu coal basins in southern Ecuador, and subsequently recorded from the lower Miocene of Lota and Coronel in Chile and the porcellanite at Siparia, Trinidad. Among recent forms it is much like certain species of *Sweetia*, *Caesalpinia*, and *Cassia*, as for example *Cassia spectabilis* De Candolle and *Cassia excelsa* Schrad. It appears most like *Cassia* but may represent some other genus of the Caesalpinieae. It is perhaps doubtful whether the recorded occurrences represent a single botanical species, although



the rather uniform climatic conditions in South America during the earlier half of the Miocene render such a conclusion not improbable, and certainly no criteria for differentiation are apparent.

The genus *Cassia* is a wide-ranging type in the existing flora of the warmer temperate and tropical regions of the world, with upward of 400 species. The geologic history of the genus goes back to the Upper Cretaceous, and more than 100 fossil species are known.

*Occurrence*.—Near Betijoque, State of Trujillo.

CASSIA ZULIANA, new species

FIGURE 29, b-e

Leaflets small, petiolulate, ovate, slightly inequilateral, widest below middle, tapering upward to acute tip which may be extended, and curving downward to the broadly cuneate to rounded inequilateral base. Margins entire. Texture subcoriaceous. Length 2.25 to 3.5 cm. Maximum width about 1.25 to 1.5 cm.

Petiolule stout, curved, about 3 mm long. Mid vein stout, prominent. Secondaries thin, about eight opposite to alternate pairs diverging from mid rib at wide angles, pursuing subparallel courses, and camptodrome in marginal region. There is considerable resemblance to the leaves of the rutaceous genus *Fagara*, but I have been unable to observe the punctations that would be decisive for the latter. Occurs also in porcellanite of Trinidad.

*Occurrence*.—Palmarejo, State of Zulia; El Mene, State of Falcon.

*Types*.—U.S.N.M. nos. 39298, 39299.

Family PAPILIONACEAE

Genus SOPHORA Linnaeus

SOPHORA MARANA, new species

FIGURE 29, f

Leaflets small, sessile, elliptical in outline, slightly inequilateral, widest in middle, with broadly rounded apex and base—the latter slightly more broadly rounded than former. Texture subcoriaceous. Margins entire, evenly rounded. Length about 2.1 cm. Maximum width 1.4 cm. Mid vein stout, mediumly prominent. Secondaries thin and largely immersed, five or six camptodrome pairs. Tertiaries obsolete.

This small leaflet is of a type commonly referred to *Sophora* and readily matched among existing species of that genus. There is no certainty, however, that it does not represent some other leguminous genus with similar leaflets.

*Occurrence*.—Palmarejo, State of Zulia.

*Type*.—U.S.N.M. no. 39300.

## LEGUMINOSAE INCERTAE SEDIS

## LEGUMINOUS POD

In the collection from locality 2 there is a specimen of a large pod obviously belonging to the leguminous alliance but not complete enough for identification. It is about 7 cm long, the proximal part missing, and about 3.5 cm in maximum width. The distal end is broadly rounded. The pod is compressed, shows no distinct outline of the contained seeds, and has a thickened margin and a faintly reticulate surface.

*Occurrence.*—Stream bank below the crossing of the Zapayari-El Plan Road, about 1½ kilometers south of Rio Grande, District of Bolivar, State of Zulia.

## Order GERANIALES

## Family TRIGONIACEAE

## Genus TRIGONIA Aublet

## TRIGONIA VARIANS Engelhardt

FIGURE 30, *a*, *b*

*Trigonia varians* ENGELHARDT, Abh. Senck. Naturf. Ges. vol. 19, p. 35, pl. 7, figs. 4-6; pl. 9, fig. 9, 1895.—?BERRY, Proc. U. S. Nat. Mus., vol. 55, p. 290, 1919; vol. 59, p. 575, pl. 107, fig. 8, 1921.

This species was described by Engelhardt from several different-sized specimens collected from tuffs near Santa Ana in the Magdalena Valley, Colombia. Rather poor material from the lower Miocene of northern Peru was tentatively identified as this species by me in 1919.

Leaves of variable size, ovate to obovate in general outline. Apex and base usually about equally pointed; sometimes apex is acuminate. Margins entire, slightly undulate. Texture subcoriaceous. Length 6 to 13 cm. Maximum width, at or slightly above middle, 3 to 5.25 cm. A maximum-sized specimen from Betijoque is shown in figure 30. Petiole stout, its length unknown. Mid vein stout, prominent on under surface of leaf, usually curved. Secondaries stout, prominent on under surface; 9 to 12 opposite to alternate pairs diverge from mid vein at fairly regular intervals and at angles of 55° or less, ascending subparallelly, becoming camptodrome in marginal region. Tertiaries thin but well marked on under side of leaf, consisting of rather closely spaced percurrent nervilles, which may be all that can be made out if the preservation is not good; these are connected by anastomosis, so that their course is usually not straight, the whole forming a relatively open, isodiametric areolation.

The genus *Trigonia*, not otherwise known in the fossil state, comprises about 30 existing species of reclined or climbing shrubs, which

are confined to the region between Central America and southern Brazil.

*Occurrence*.—Palmarejo, District of Mara; La Victoria-Catanaja Road about 2½ kilometers north of La Victoria, District of Miranda, State of Zulia; El Mene, District of Acosta, State of Falcon (doubtful material); Betijoque, near La Salvadora, District of Betijoque, State of Trujillo. U.S.N.M. nos. 39301, 39302.

## Order SAPINDALES

### Family ANACARDIACEAE

#### Genus TAPIRIRA Aublet

#### TAPIRIRA LANCEOLATA Engelhardt

FIGURE 30, *e, f*

*Tapirira lanceolata* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 15, pl. 9, fig. 4, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 55, p. 291, pl. 15, fig. 1, 1919.

The specimens from Palmarejo are slightly smaller and more acuminate than the type, but it is legitimate to expect such slight variations in size and form in the leaflets of pinnate leaves. The general form and venation are identical.

The species was described by Engelhardt from the inter-Andean basin of Loja in Ecuador and recorded by me from the Zorritos formation (lower Miocene) of the north Peruvian oilfield. It is also represented in collections from the De Mares Concession in Colombia.

*Occurrence*.—Palmarejo, District of Mara; Zapayari-El Plan Road 1½ kilometers south of Rio Grande, District of Bolivar, State of Zulia; El Mene, District of Acosta, State of Falcon. U.S.N.M. no. 39303.

#### TAPIRIRA TRINITIANA Berry

FIGURE 30, *d*

*Tapirira trinitiana* BERRY, Johns Hopkins Univ. Studies in Geol., no. 6, p. 103, pl. 14, fig. 4, 1925.

This species was described from the Forest sand of Trinidad, British West Indies. The genus is shrubby or arborescent, with not more than six or eight existing species confined to tropical South America. Miocene or Pliocene species have been recorded from Colombia, Ecuador, and Peru.

*Occurrence*.—La Victoria-Catanaja Road, about 2½ kilometers north of La Victoria, District of Miranda, State of Zulia. U.S.N.M. no. 39304.

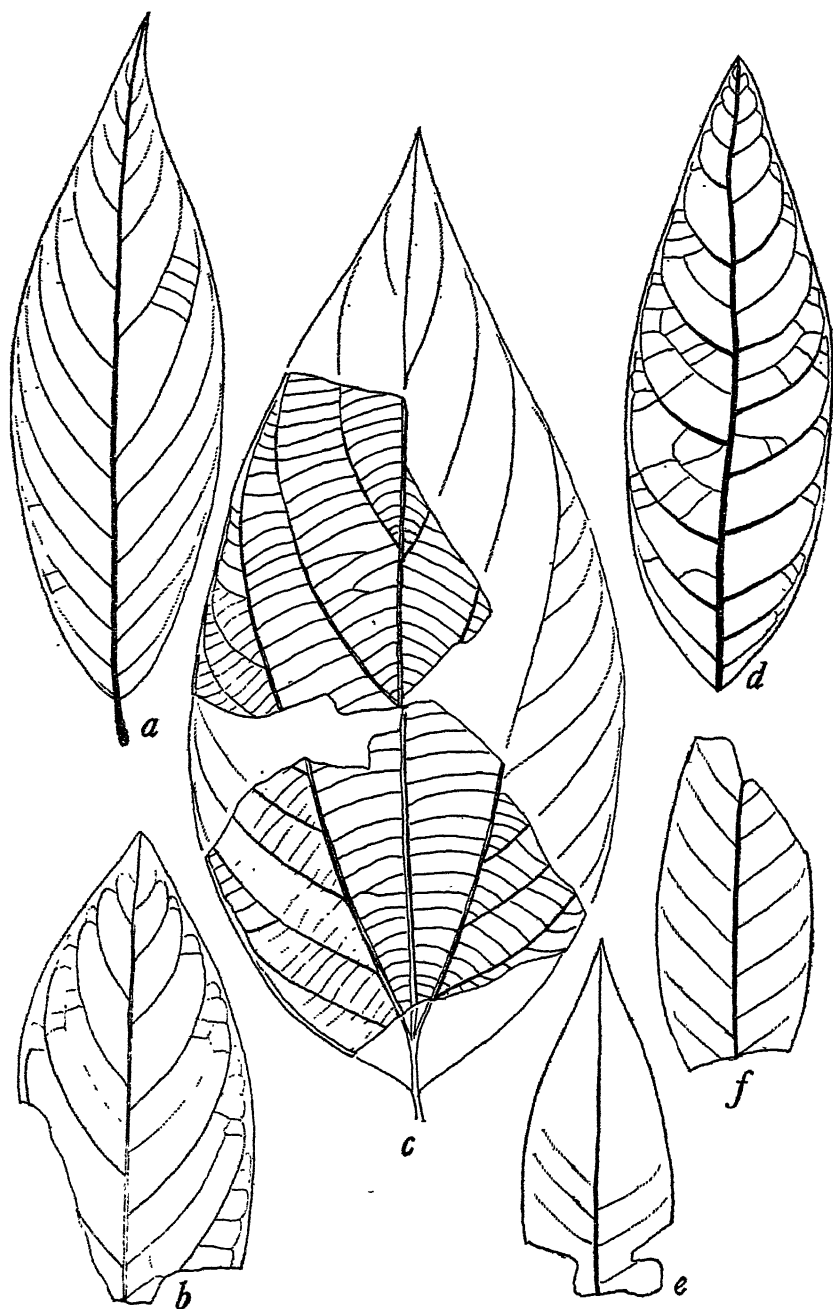


FIGURE 30.—*a, b*, *Trigonia varians* Engelhardt (*a*, La Victoria; *b*, Palmarejo); *c*, *Hernandia tongi*, new species (2½ kilometers north of La Victoria); *d*, *Tapirira trinitiana* Berry (2½ kilometers north of La Victoria); *e, f*, *Tapirira lanceolata* Engelhardt (Palmarejo). All about three-fourths natural size.

## Order LAURALES

## Family HERNANDIACEAE

Genus *HERNANDIA* Linnaeus*HERNANDIA TONGLI*, new species

FIGURE 30, c

Leaves of medium to small size for this genus, ovate in outline, with a broadly rounded base and an acuminate tip. Margins entire. Texture subcoriaceous. Length 10.5 to 17 cm. Maximum width, at or below middle, 4.5 to 9 cm. Petiole not preserved. Mid vein stout and prominent on under side of leaf. Lateral primaries one on each side, opposite, stout, and prominent, diverging from mid vein at acute angles at a greater or less distance above its base, ascending and dying out subparallel to lateral margins one-half to two-thirds distance to tip. Secondaries mediumly stout, alternate to subopposite, three to five pairs, diverging from mid vein at angles of 45° or less, ascending in regular sweeping curves, camptodrome.

From outer side of lateral primaries there are numerous stout, regularly and closely spaced, camptodrome secondaries, which diverge at acute angles and are subparallel. Tertiaries well marked, comprising closely spaced and mostly simple veins at right angles to primaries and secondaries.

This is a type of Tertiary leaf that has frequently been referred to the genus *Ficus*, as in the case of the *F. mississippiensis* group of the Eocene in the United States,<sup>5</sup> but that probably is not related to *Ficus*. It is also very similar to the leaves of entire *Sterculias*. Several of these may profitably be compared with the modern species of *Hernandia*.

This species is present in the Miocene of the De Mares Concession in the Magdalena Valley, Department of Santander, Colombia.

*Occurrence*.—La Victoria-Catanaja Road, about 2½ kilometers north of La Victoria, District of Miranda; Zapayari-El Plan Road, 1½ kilometers south of Rio Grande, District of Bolivar, State of Zulia.

*Type*.—U.S.N.M. no. 39305.

## Family LAURACEAE

Genus *NECTANDRA* Roland*NECTANDRA AREOLATA* Engelhardt

*Nectandra areolata* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 29, pl. 6, figs. 1, 2, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 177, pl. 27, 1921; vol. 62, art. 19, p. 19, pl. 4, fig. 3, 1923; vol. 75, art. 24, p. 9, 1929.

<sup>5</sup> See Berry, E. W., U. S. Geol. Surv. Prof. Paper 131, pp. 9-12, 1922.

This rather large and coarse form was described originally from Santa Ana, Colombia, and has since been recorded from Leiva, Colombia; Oaxaca, Mexico; and Costa Rica.

*Occurrence*.—Palmarejo, District of Mara; Zapayari—El Plan Road, about 1½ kilometers south of Rio Grande (a doubtful specimen), District of Bolivar, State of Zulia.

#### Genus *PERSEA* Gaertner filis

##### *PERSEA CORIACEA* Engelhardt

*Persea coriacea* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 26, pl. 6, figs. 3, 4, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 75, art. 24, p. 9, pl. 5, fig. 3, 1929.

Another large and coarse lauraceous leaf, distinguished with difficulty from *Nectandra areolata*. It was described originally from Santa Ana, Colombia, and has since been recorded from Leiva and the De Mares Concession of that country.

*Occurrence*.—El Mene, District of Acosta, State of Falcon.

##### *PERSEA* species

Similar to *P. coriacea* from El Mene in Venezuela and from Santa Ana and Leiva, Colombia, but somewhat less coarse, with more numerous secondaries.

*Occurrence*.—Palmarejo, District of Mara; La Victoria—Catanaja Road, about 2½ kilometers north of La Victoria, District of Miranda, State of Zulia.

### Order MYRTALES

#### Family COMBRETACEAE

##### Genus *COMBRETUM* Linnaeus

##### *COMBRETUM STEPHENSONI*, new species

##### FIGURE 31, *d*

Leaves broadly elliptical or elliptical-ovate. Tip rounded. Base broadly cuneate to rounded. Margins entire. Texture coriaceous. Length about 11 cm. Maximum width about 6.5 cm. Petiole missing. Mid vein mediumly stout, channeled on upper surface, prominent on lower surface. Secondaries mediumly stout, numerous, mostly alternate, somewhat irregularly spaced; they diverge from mid vein at wide angles, are regularly curved and subparallel, and are camptodrome in marginal region. Tertiaries mostly percurrent, especially over short distances, mostly immersed in the leaf substance.

This species is represented by a considerable quantity of material, but all is in a much broken condition. It is, of course, hazardous to base species on limited material, since the leaves of existing species are inclined to variability, and in the only fossil species of which I have seen a large quantity of good material, i. e., *Combretum petraflumensis* Berry<sup>6</sup> from the middle Eocene of the Mississippi embayment, the leaves are extraordinarily variable. There is, however, a generic facies not easily mistaken. Leaves of this type are not uncommon from the Eocene onward; indeed they are foreshadowed during the Upper Cretaceous. Among previously described forms the present species is much like *C. incertum* Berry<sup>7</sup> from the Miocene porcellanite of Siparia, Trinidad, British West Indies.

The genus contains about 150 existing tropical and often coastal species, at least a third of which are natives of South America.

*Occurrence.*—La Victoria-Catanaja Road, about 2½ kilometers north of La Victoria, and 3½ kilometers south of La Victoria, one-half kilometer southwest of El Rudal ranch, District of Miranda, State of Zulia.

*Type.*—U.S.N.M. no. 39306.

## Order EBENALES

### Family STYRACACEAE

#### Genus STYRAX Linnaeus

##### STYRAX LANCEOLATA Engelhardt

*Styrax lanceolata* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 32, pl. 5, fig. 9, 1895.

This small leaf was described by Engelhardt from Santa Ana, Colombia, and has not been detected elsewhere until now.

*Occurrence.*—El Mene, District of Acosta, State of Falcon.

### Family SAPOTACEAE

#### Genus ACHRAS Linnaeus

##### ACHRAS CALCICOLAFOLIA, new species

##### FIGURE 31, a

Leaves large, oblong, widest medianly and tapering about equally distad and proximad. Apex and base shortly obtusely pointed. Margins entire, full and evenly rounded. Texture coriaceous. Length about 20 cm. Maximum width about 7.5 cm. Petiole missing.

<sup>6</sup>Berry, E. W., U. S. Geol. Surv. Prof. Paper 92, p. 85, pls. 45, 58, 59, 1924.

<sup>7</sup>Berry, E. W., Johns Hopkins Univ. Studies in Geol., no. 6, p. 117, pl. 8, fig. 2, 1925.

Mid vein stout, channeled on upper surface, prominent on lower surface. Secondaries thin, immersed in the leaf substance; they are numerous and subparallel, diverging from the mid vein at angles of 70° to 80°, pursuing almost straight courses, and are abruptly camptodrome within the margins. Tertiary venation obsolete.

Leaves of this sort are represented in many families, notably in the Moraceae and Apocynaceae and by such genera as *Ficus*, *Allamanda*, and *Plumeria*. After extended comparisons with recent material I find the fossil leaves to be most like the leaves of *Achras*, especially *A. chicle* Pittier of Guatemala and *A. calcicola* Pittier of the rain forest of Panama. These two are much closer than the leaves of South American species of *Achras* that I have seen.

*Occurrence*.—La Victoria—Catanaja Road, about 2½ kilometers north of La Victoria, District of Miranda, State of Zulia.

*Type*.—U.S.N.M. no. 39307.

## Order GENTIALALES

### Family APOCYNACEAE

#### Genus APOCYNOPHYLLUM Unger

##### APOCYNOPHYLLUM SALVADORENSIS Berry

*Apocynophyllum salvadorensis* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 579, pl. 107, fig. 6, 1921.

This species was based upon three specimens collected by C. F. Bowen in 1919 from the sandy clays 2½ miles northwest of La Salvadora, Venezuela. It was described as follows:

Leaves linear-lanceolate in outline, about 13 cm in length and 2.4 cm in maximum width, with a somewhat narrowed rounded base. Apex missing, so that the total length as given may be slightly overestimated. Margins entire, even. Petiole missing. Mid rib thin on upper surface of leaf, stout and prominent on lower surface. Secondaries numerous, thin, regularly spaced, subparallel, and camptodrome.

This species is of a somewhat uncertain botanical affinity, since it exhibits no conclusive diagnostic characters. It approaches nearest to the various fossil species that have been referred to the form genus *Apocynophyllum* and that suggest various existing tropical genera of the family Apocynaceae, such as *Plumeria*, *Prestonia*, and *Thevetia*. This same species is contained in later collections from Venezuela.

*Occurrence*.—Palmarejo, District of Mara, State of Zulia; El Mene, District of Acosta, State of Falcon; near La Salvadora, State of Trujillo.



## Order PERSONALES

## Family BIGNONIACEAE

## Genus PLEONOTOMA Miers

## PLEONOTOMA MIOCENICA, new species

## FIGURE 31, b

Leaflets small, subelliptical, slightly inequilateral, about equally narrowed and rounded at both ends. Margins entire. Texture subcoriaceous. Length about 4.5 cm. Maximum width about 1.8 cm. Apparently sessile. Mid vein stout, prominent, curved. Secondaries stout, prominent, four or five pairs, irregularly spaced, ascending, camptodrome, connected by mostly simple transverse tertiaries.

This species appears to represent the genus *Pleonotoma*, not hitherto known as a fossil. The genus contains six or eight recent species of climbing shrubs in the region between the Caribbean and southern Brazil. Among these, *P. jasminifolium* (H. B. K.) Miers of the Venezuelan region appears to be most like the fossil. There is also considerable similarity to the Brazilian species *P. tetraquetrum*, the *Bignonia triphylla* of Miers. The first is bipinnate and the second trifoliate in habit.

*Occurrence*.—Betijoque, District of Betijoque, State of Trujillo.

*Type*.—U.S.N.M. no. 39308.

## Genus BIGNONIA Linnaeus

## BIGNONIA ZULLANA, new species

## FIGURE 31, c

Leaflets petiolate, ovate, medium sized, widest medianly, sharply pointed but not extended distad, pointed and slightly decurrent proximad. Margins entire. Texture subcoriaceous. Length about 11.25 cm. Maximum width about 5.25 cm. Petiole mostly missing. Mid vein stout, prominent, slightly curved. Lateral primaries one on each side, suprabasilar, stout, diverging at acute angles and terminating camptodromely in upper half of leaflet. There are three or four regularly curved, prominent, camptodrome secondaries in upper half of leaflet. Tertiaries thin but well marked, numerous, and camptodrome within the margins, transverse, simple, and curved or sometimes inosculating. Ultimate areolation indistinct.

This species, which suggests comparisons with certain lauraceous forms, agrees more closely with various existing species of the large tropical genus *Bignonia* and is approximated by existing forms from various parts of South America. Among those seen the follow-

ing are the most similar: *B. barbinervis*, *B. eximia*, and *B. cujabamba*.

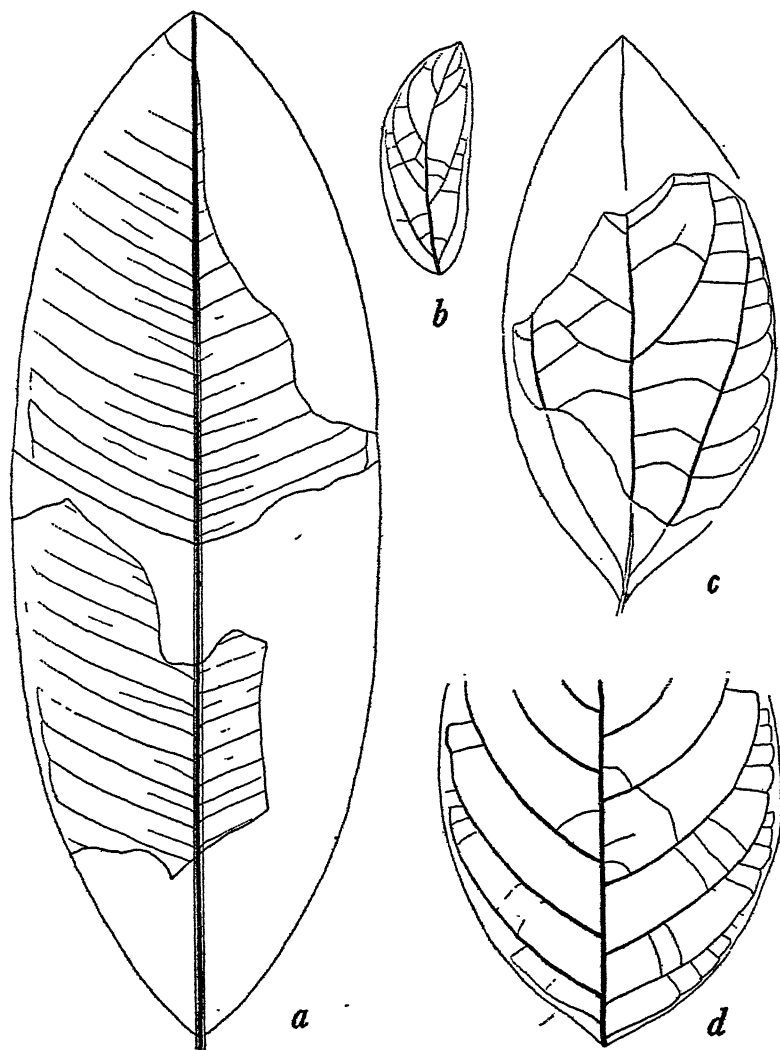


FIGURE 31.—*a*, *Achras calcicolafolia*, new species (2½ kilometers north of La Victoria); *b*, *Pleonotoma miocenica*, new species (Betijoque); *c*, *Bignonia zuliana*, new species (2½ kilometers north of La Victoria); *d*, *Combretum stephensoni*, new species (2½ kilometers north of La Victoria). All about three-fourths natural size.

*Occurrence*.—La Victoria-Catanaja Road, 2½ kilometers north of La Victoria, District of Miranda, State of Zulia.

*Type*.—U.S.N.M. no. 39309.

## Order RUBIALES

## Family RUBIACEAE

## Genus CONDAMINEA De Candolle

## CONDAMINEA (?) GRANDIFOLIA Engelhardt

*Condaminea grandifolia* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 34, pl. 7, fig. 2; pl. 9, fig. 1, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 55, p. 293, pl. 17, 1919.

Fragments of a large leaf with the characteristic venation of this species occur at Palmarejo. I have no doubt that they represent the same species, which was described by Engelhardt from Santa Ana, Colombia, and which is abundant in the Zorritos formation (lower Miocene) of the north Peruvian oilfield. As I have previously stated (op. cit., p. 294), I much doubt their reference to this genus.

*Occurrence*.—Palmarejo, State of Zulia.

## Genus SABICEA Aublet

## SABICEA ASPERIFOLIA Engelhardt

*Sabicea asperifolia* ENGELHARDT, Abh. Senck. Naturf. Ges., vol. 19, p. 40, pl. 5, fig. 6; pl. 8, fig. 6, 1895.

This species was described by Engelhardt from the Tertiary of the Cauca Valley, Colombia. It is abundantly represented by leaves of various sizes in a somewhat fragmentary condition in the clays at Betijoque. The narrower forms are superficially like *Apocynophyllum salvadorensis* Berry from the Miocene of La Salvadora, Venezuela, but the leaves are less oblong and more ovate, the secondaries are less regular and stouter, the tertiaries are much more prominent, the areolation differs, and the base is more cuneate.

*S. asperifolia* is also something like *Tapirira lanceolata* Engelhardt of the family Anacardiaceae, described from the Tertiary of Loja, Ecuador, and recorded from the Miocene of Peru (see p. 352). It is also much like the existing *S. aspera*, which resemblance has suggested the name of the fossil species.

# PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

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## THREE NEW MILLIPEDS OF THE ORDER COLOBOG- NATHA FROM TENNESSEE, TEXAS, AND LOWER CALIFORNIA, WITH RECORDS OF PREVIOUSLY KNOWN SPECIES

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By H. F. LOOMIS

*Bureau of Plant Industry, United States Department of Agriculture*

A PAPER in which the 12 known species of the milliped order Colobognatha in the United States were alluded to in descriptions, keys, or diagnoses appeared in 1928.<sup>1</sup> Since then three additional species of the order have been discovered, and although one of them was found in an unrecorded locality in Lower California, all its close relatives are members of our fauna, and there is possibility of its range extending into the United States in the southern California mountains adjacent to the Mexican Boundary. This species and another new one from Tennessee belong in the genus *Brachycybe*, and they double the number of species it contains. The third species is from near Brownsville, Tex., and extends the tropical genus *Siphonophora* within our borders. Descriptions of these new species and several new locality records of previously known forms are herein presented. The type specimens of the new species are in the United States National Museum.

<sup>1</sup> Cook, O. F., and Loomis, H. F., Millipeds of the order Colobognatha, with descriptions of six new genera and type species, from Arizona and California. Proc. U. S. Nat. Mus., vol. 72, art. 18, pp. 1-26, 1928.

## Genus SIPHONOPHORA Brandt

## SIPHONOPHORA LIMITARE, new species

Two males, one the type (U.S.N.M. milliped no. 1159), and three females collected at Brownsville, Tex. (without date), by H. S. Barber, of the U. S. Bureau of Entomology and Plant Quarantine.

*Diagnosis.*—The combination of characters exhibited by the head, i. e., the rounded sides, short beak, and the short and stout antennae, has not been reported for any other Central American or Mexican species of this genus. The broad, thin, truncated terminal joint of the anterior gonopods also seems very distinctive of this species.

*Description.*—Body slender; the largest specimen, a female, is 16 mm long and 0.7 mm wide and has 80 segments; the other two females have 44 and 63 segments; the male type has 78 segments, and the other male 68. Dorsal surface of body invested with very short, erect pubescence.

Head short, subglobose, the sides slightly rounded (fig. 32, *a*). Beak a little over half the length of rest of head, very slightly decurved, and with a cluster of long hairs at base on under side. Antennae short and stout, not so long as head, and with tip of beak reaching opposite middle of sixth joint (fig. 32, *b*).

First segment with anterior margin evenly and shallowly emarginate. Segments 2, 3, and 4 shorter than ensuing ones and much more convex longitudinally. Repugnatorial pores large and opening from slight conic elevations.

Anterior gonopods short and crassate, subglobose, coarsely hairy, the joints indistinct. What appears to be the terminal joint is short, broad, and thin, and the apex is transversely and obliquely truncated. Posterior gonopods long and slender, extending forward between anterior gonopods and exceeding their tips; apical joint longer than other joints.

*Remarks.*—This is the first record of a species of this genus in the United States, although species of closely related genera are known from Arizona and California. Partly on the basis of finding, in a few especially favored localities in south Texas, a number of delicate, humus-inhabiting arthropods and two millipeds associated with tropical forms, it has been inferred that in former times extensive forests were present in the region and allowed a general distribution of humus animals, which later were restricted and isolated by changing conditions.<sup>2</sup> The discovery of a species of *Siphonophora* in the

<sup>2</sup> Cook, O. F., Change of vegetation on the south Texas prairies. U. S. Bur. Plant Industry Circ. 14, 1908.

Cook, O. F., Notes on the distribution of millipeds in southern Texas, with descriptions of new genera and species from Texas, Arizona, Mexico, and Costa Rica. Proc. U. S. Nat. Mus., vol. 40, pp. 147-167, 1911.

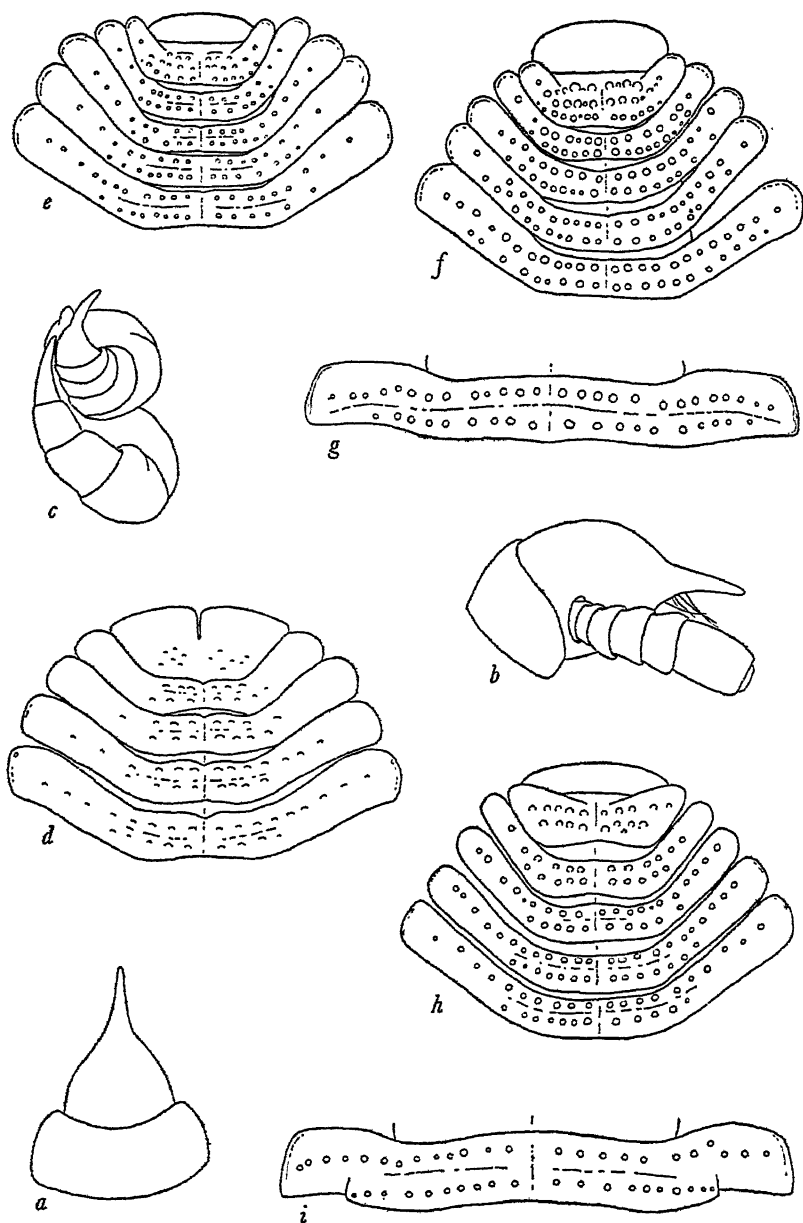


FIGURE 32.—*a, b*, *Siphonophora limitare*, new species, *a*, dorsal, and *b*, lateral view of head and first segment; *c*, *Gosodesmus claremontus* Chamberlin, anterior and posterior gonopod; *d*, *Brachycybe petasata*, new species, dorsal view of anterior end of body; *e*, *B. lecontei* Wood, dorsal view of anterior end of body; *f*, *g*, *B. rosea* Murray, *f*, dorsal view of anterior end of body, *g*, dorsal view of a mid-body segment; *h*, *i*, *B. producta*, new species, *h*, dorsal view of anterior end of body, *i*, dorsal view of a mid-body segment. (All figures of *Brachycybe* drawn to same scale.)

region is additional and more conclusive evidence of the previous existence of tropical conditions, for all the members of this genus are distinctly tropical and of delicate structure and sluggish habits, which combine to restrict their distribution and make migration a slow process dependent on the constant protection of a moist humus layer, such as usually is found in tropical forests. Because of the persistence of such types as *Siphonophora*, it is evident that in small areas in south Texas satisfactory environmental conditions for humus animals have been maintained with unbroken continuity since the disappearance of the forests, and through the period of changing vegetation, to the present day.

**Genus SIPHONACME Cook and Loomis**

**SIPHONACME LYTTONI Cook and Loomis**

In addition to the type locality, which is near the highest point of the road between Miami and Superior, Ariz., the species has since been collected by me at Prescott and in Cave Creek Canyon of the Chiricahua Mountains, Ariz.

**Genus ANDROGNATHUS Cope**

**ANDROGNATHUS CORTICARIUS Cope**

Previously reported from Virginia and Tennessee. Specimens have been collected at Quincy, Fla., by Dr. O. F. Cook, thus considerably extending the range to the south and indicating that the species will probably be found in several States from which it has never been reported.

**Genus GOSODESMUS Chamberlin**

**GOSODESMUS CLAREMONTUS Chamberlin**

As the names implies, the type locality of this species is Claremont, Calif. Additional specimens have been collected by Dr. O. F. Cook in the following California localities: "South of Pescadero"; Santa Cruz Mountains, between Santa Cruz and Holy City; Santa Monica.

The male gonopods are shown in figure 32, c.

**Genus BRACHYCYBE Wood**

This is probably the most interesting genus of the order in the United States because of its wide distribution, its species being found on the Pacific coast as well as on the Atlantic seaboard, whereas the other genera are monospecific, except *Siphonacme* and *Siphonophora*, and their species restricted to one side of the continent or the other.

One of the chief differences recognized between the previously established species of *Brachycybe* has been the number of segments, the eastern *lecontei* having less than 50 and the western *rosea* more than 60. Two new members of this genus are herein described, one from each side of the continent. The conformity of each new species, in number of segments, with the species previously known in its respective region, may signify descent from a common ancestor, but the structural differences between the two eastern species, or between the two western ones, are sufficiently numerous and extreme to have required a very long time for their development. The common prehistoric home of the two branches of the genus is a matter of doubt but may have been Mexico or Central America rather than the United States, as extension from a single source in the United States to both sides of the continent is more difficult to explain than migration from a more southern source.

The four species of this genus are separated in the following key:

#### KEY TO THE SPECIES OF BRACHYCYBE

1. Head completely hidden beneath first segment, which has the lateral carinae produced forward and expanded inward, occupying almost the entire front margin; surface of disk very faintly tuberculate..... petasata, new species  
 Head exposed between the short, oblique, lateral carinae of first segment, the disk of which is strongly tuberculate..... 2
2. Body stout, 4 or 5 times as long as broad; number of segments not exceeding 50..... lecontei Wood  
 Body slenderer, 7 to 12 times as long as broad and with 60 to 75 segments..... 3
3. Body about 7 times as long as broad; first segment with 3 transverse rows of tubercles and with lateral carinae obliquely produced forward; posterior margin of mid-body segments continuous throughout..... rosea Murray  
 Body 10 to 12 times as long as broad; first segment with 2 transverse rows of tubercles and with lateral carinae scarcely produced; posterior margin of mid-body segments interrupted at base of each lateral carina..... producta, new species

#### BRACHYCYBE PETASATA, new species

Many specimens were collected in the Cherokee National Forest, Tenn., November 1, 1929, by Dr. O. F. Cook. The type (U.S.N.M. milliped no. 1160) is a male.

*Diagnosis.*—The enlarged first segment, which completely hides the head from above, immediately distinguishes this species.

*Description.*—Length of largest specimen 18 mm, width 3 mm; number of segments 40 to 49. Anterior end of body suddenly broadened from in front.

Head hidden beneath first segment when viewed from above (fig. 32, ♂).



First segment large, lateral carinae produced forward and expanded inward, almost joined along longitudinal axis of body above head, sinus between carinae long and narrow; surface of segment with a few small indistinct tubercles on posterior portion.

Other segments with two transverse rows of rather large, low, rounded tubercles; anterior row crossing dorsum and median portion of lateral carinae almost to lateral margin and containing 14 to 22 tubercles; posterior row containing but 6 to 12 tubercles and these not extending onto lateral carinae; a transverse furrow is strongly evident on dorsum between the two rows of tubercles but does not extend onto the carinae.

Anal valves together are hemispherical, the inner margins not meeting in a reentrant angle as in the other three species.

The alcoholic specimens are creamy white; the living colors are not recorded.

#### BRACHYCYBE LECONTEI Wood

*Brachycybe lecontei* Wood, Proc. Acad. Nat. Sci. Philadelphia, 1864, p. 187.

In order to place this species on the same taxonomic footing as the other members of the genus, the following brief description has been prepared:

*Description*.—Length of largest specimen 13 mm, width 3 mm. Number of segments in the two specimens examined 40 and 42 (Wood reported 47 segments); anterior end of body suddenly broadened from in front (fig. 32, *e*).

Head not covered by first segment.

First segment with lateral carinae short but extending obliquely forward a considerable distance, the head visible between them. Anterior median margin transverse. Surface with small but very evident tubercles in three irregular transverse rows.

Other segments with two transverse rows of small hemispherical tubercles extending across dorsum and onto lateral carinae, the anterior row with 20 to 32 tubercles and the posterior row with a somewhat smaller number. The transverse furrow between the rows of tubercles is strongly impressed on dorsum and extends across each lateral carina to margin, just behind repugnatorial pore; the furrow is broader and less conspicuous on the carinae.

Anal valves strongly inflated, meeting at a reentrant angle.

*Remarks*.—The two females from which these notes were derived were collected at Tallulah, Ga., in 1887, and probably are those reported by Bollman.<sup>3</sup> Wood's specimens came from Georgia, and his figures of them leave no doubt as to the identity of the Tallulah specimens. The recognition of *B. petasata* from Tennessee places

<sup>3</sup> U. S. Nat. Mus. Bull. 46, p. 189, 1893.

previous records of *B. lecontei* from there and from Arkansas (Bollman) in question. The Tennessee specimens may have been *petasata* and the Arkansas ones the same or even an undescribed species. Considerable collecting must be done in these States to determine what species occur, the old records no longer being reliable.

#### BRACHYCYBE ROSEA Murray

*Brachycybe rosea* MURRAY, Economic entomology, Aptera, p. 21, 1877.

*Platydesmus californicus* KARSCH, Mitth. Münch. Ent. Vereins, vol. 4, p. 144, 1880.

Murray and Karsch gave only "California" as the locality for their specimens. Those I have seen were collected at the Sunnyside mine, near Seneca, Plumas County, Calif., by H. S. Barber in 1922, and a description and photographs of this material appeared in the paper hereinbefore referred to.<sup>4</sup>

Drawings of the head and anterior segments of one of these specimens are shown in figure 32, *f* and *g*, for purposes of comparison with drawings of other species. The gradual widening of the anterior segments from in front is a character of the two Pacific coast species, as is the rapid widening of the same segments characteristic of the eastern species.

#### BRACHYCYBE PRODUCTA, new species

Two bottles in the National Museum collection contain specimens labeled: (1) "*Platydesmus*, Lower Calif. Com. Dr. Marx"; (2) "Calif. Acad. Sci. Com. Dr. Marx 10/93." The first bottle contains one female, the other two males and three females. Although the latter bottle is without locality data, the similarity of the females to the one in the first bottle is unmistakable, and it is quite possible, and indeed probable, that all specimens were collected at about the same time and in the same place, which may have been in a wooded section of the central mountainous portion of Lower California. If the latter conjecture should prove true, it would not be unreasonable to suppose that the species may occur in some of the southern California mountains.

The type (U.S.N.M. milliped no. 1161) is a male.

*Diagnosis.*—The principal differences between this species and *B. rosea* are the longer body, the shape of the first segment, its fewer rows of tubercles, the interrupted posterior margin of the median segments, and the abbreviated posterior row of tubercles on these segments.

*Description.*—Body longer and slenderer than any other species and slightly more convex. The largest specimen, a female, is 38

<sup>4</sup> Proc. U. S. Nat. Mus., vol. 72, art. 18, pp. 24-25, pl. 1, 1928.

mm long and 3.3 mm wide and has 72 segments. The male type is 35 mm long, 3.2 mm wide, and has 75 segments. Anterior end of body widening gradually from in front (fig. 32, *h*).

First segment scarcely wider than head; lateral carinae less developed than in other species and more transverse; surface with two transverse rows of rounded tubercles.

Except for a few segments at each end of the body, the others have the posterior margin abruptly interrupted on each side of the dorsum at the base of the lateral carina, the margin between the carinae being produced backward and having a right-angled corner at the base of the carina (fig. 32, *i*).

Segments with two transverse rows of smaller tubercles on the dorsum than in *B. rosea*, the anterior row extending across lateral carinae and containing 20 to 30 tubercles; posterior row ending near angulation of posterior margin, not extending onto carinae, and containing 14 to 22 tubercles.

Anal valves inflated and meeting at a reentrant angle.



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A REVISION OF THE CHALCID FLIES OF THE GENUS  
*PERILAMPUS* LATREILLE OCCURRING IN AMERICA  
NORTH OF MEXICO

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of Agriculture*

THE STUDIES underlying this paper are based upon specimens in the collections of the United States National Museum, Washington; the Academy of Natural Sciences of Philadelphia; the American Museum of Natural History, New York; the Boston Society of Natural History; the Museum of Comparative Zoology, Cambridge, Mass.; the field laboratory of the U. S. Bureau of Entomology and Plant Quarantine at Melrose Highlands, Mass.; and of Prof. C. T. Brues, of Harvard University. I am indebted to these institutions and to Professor Brues for the loan of specimens and to A. B. Gahan and C. F. W. Muesebeck, of the U. S. Bureau of Entomology and Plant Quarantine, for many helpful suggestions and for criticism of the manuscript. My thanks are also due Nathan Banks, of the Museum of Comparative Zoology, and D. L. Parker and P. B. Dowden, of the Bureau of Entomology and Plant Quarantine, for help given me from time to time.

Most of the types of the species of the genus *Perilampus* are in the collection of the United States National Museum and have been studied. The types of *hyalinus* Say and *platygaster* Say are evidently lost, and in the identification of these species I have followed such workers as A. B. Gahan, of the U. S. Bureau of Entomology and Plant Quarantine, and J. C. Crawford, formerly of the Bureau of Entomology. It is difficult to say, in the absence of the types, whether the

identifications are correct. Those specimens called *P. platygaster*, I might say, judging from the description, may well be some other species. The identification of *P. hyalinus*, on the other hand, is likely correct, although the possibility of the specimens so identified being *carolinensis*, a closely related but rarer species, which I have described herein as new, must not be overlooked, for both species were considered as *hyalinus* in the past. The types of Provancher's three species—*stygicus*, *aciculatus*, and *laevis*—are in Canada; the first two are in the Museum of Public Instruction in Quebec, and the last in the Harrington Collection in Ottawa.<sup>1</sup> I have not seen these, and I am unable to place *laevis*, at least. *P. aciculatus* is probably *hyalinus* Say, and I have synonymized it, questioningly, with this species. I am also unable to place *cyaneus* Brullé, the type of which I presume to be in the Muséum d'Histoire Naturelle in Paris, or *alexinus* Walker, *entellus* Walker, and *lepreos* Walker, the types of which are presumably in the British Museum. For a further mention of *laevis*, *cyaneus*, *alexinus*, *entellus*, and *lepreos*, see "Unidentified Species" (p. 410).

Twenty-two valid species and varieties are recognized in this paper, of which ten are described as new to science.

As may be seen from the key or table to species, the genus *Perilampus* divides itself naturally into two sections and each section in turn into smaller groups of species.<sup>2</sup> Section I, composed of what I term the "carinate species", from the presence of a well-defined carina on the frons, includes (1) the *hyalinus* group and (2) the *platygaster* group<sup>3</sup>; and section II, the "noncarinate species", includes (1) the single species comprising the *canadensis* group, (2) the *chrysopae* group, (3) the *anomocerus* group, and (4) the *fulvicornis* group. The species *canadensis*, which stands at the head of the noncarinate list in the key, could properly be included in the *chrysopae* group, but I prefer to keep it separate, for the present at least, because of its resemblance in certain respects, especially in the character of its first tergite, to the *hyalinus* group of species in section I. The following outline will show the species in accordance with the above grouping:

#### SECTION I (CARINATE SPECIES)

- |                           |   |                                    |
|---------------------------|---|------------------------------------|
| 1. Hyalinus group-----    | { | <i>carolinensis</i> , new species. |
|                           |   | <i>regalis</i> , new species.      |
|                           |   | <i>hyalinus</i> Say.               |
|                           | { | <i>platygaster</i> Say.            |
| 2. Platygaster group----- |   | <i>crawfordi</i> , new species.    |
|                           |   | <i>subcarinatus</i> Crawford.      |
|                           |   | <i>carinifrons</i> Crawford.       |
|                           | { | <i>ocellatus</i> , new species.    |

<sup>1</sup> Gahan, A. B., and Rohwer, S. A., Can. Ent., vol. 50, p. 106, 1918.

<sup>2</sup> Only the principal characters are used in the key in differentiating the groups, and in some cases again the characters used are not all true group characters.

<sup>3</sup> The group name is derived from the oldest described species in each.

## SECTION II (NONCARINATE SPECIES)

- |                           |   |   |
|---------------------------|---|---|
| 1. Canadensis group-----  | { | <i>canadensis</i> Crawford.                     |
|                           |   | <i>canadensis nitidus</i> , new variety.        |
| 2. Chrysopae group-----   | { | <i>chrysopae</i> Crawford.                      |
|                           |   | <i>rohweri</i> , new species.                   |
|                           |   | <i>capitatus</i> , new species.                 |
| 3. Anomocerus group-----  | { | <i>anomocerus</i> Crawford.                     |
|                           |   | <i>granulosus</i> Crawford.                     |
|                           |   | <i>gahani</i> , new species.                    |
|                           |   | <i>fulvicornis</i> Ashmead.                     |
|                           |   | <i>fulvicornis prothoracicus</i> , new variety. |
| 4. Fulvicornis group----- | { | <i>stygius</i> Provancher.                      |
|                           |   | <i>similis</i> Crawford.                        |
|                           |   | <i>muessebecki</i> , new species.               |
|                           |   | <i>robertsoni</i> Crawford.                     |

## Superfamily CHALCIDOIDEA

## Family PERILAMPIDAE

## Genus PERILAMPUS Latreille

*Perilampus* LATREILLE, *Genera crustaceorum et insectorum*, etc., vol. 4, p. 30, 1809. (Genotype, *Diplolepis violacea* Fabricius, designated by Latreille, *Considérations générales sur l'ordre naturel des animaux*, etc., p. 436, 1810.)

*Cynipsillum* LAMARCK, *Histoire naturelles des animaux sans vertèbres*, vol. 4, p. 156, 1817 (p. 366 in ed. 2, 1835). (Genotype, *Chalcis violacea* Panzer, designated by Gahan and Fagan, *U. S. Nat. Mus. Bull.* 124, p. 41, 1923.)

Head as broad as thorax; frontovertex deeply emarginate; clypeus clearly defined, separated from rest of face by a suture; mandibles strong, the right tridentate, the left bidentate; antennae inserted about in the middle of the head, well above level of lower margins of eyes, with 13 distinct segments, with only one ring joint, scape not quite reaching anterior ocellus, flagellum fusiform to subclavate; thorax coarsely umbilicately punctured; pronotum short; dorsal line of prepectus generally as long as or longer than prothorax, suture separating it from latter sometimes indistinct; mesonotum with parapsidal furrows converging; axillae triangular, not widely separated; scutellum sometimes produced at apex but never produced into a spear-shaped process or spine; costal cell about two to three times as long as the marginal vein; marginal vein longer than the postmarginal, rarely only as long; stigmal vein shorter than postmarginal, very rarely about as long; abdomen very shortly petiolated; first tergite (petiole) transversely linear to nearly as long as broad, with anterior margin frequently elevated into a flangelike projection, smooth to coarsely sculptured; abdomen entirely or in greater part smooth and polished, second and third segments (first and second of the gaster) entirely or almost entirely covering remaining segments.

The species of *Perilampus* appear to be largely hyperparasitic. They are characterized by an active first-stage larva, termed "plani-

dium", a type of larva originally discovered by Dr. W. M. Wheeler in connection with his studies of the eucharid species *Orasema viridis* Ashmead<sup>4</sup> and discovered in *Perilampus* by Harry S. Smith in his studies of the life history and habits of *Perilampus hyalinus* Say.<sup>5</sup>

#### KEY TO THE SPECIES OF PERILAMPUS

1. Frons with a carina extending from behind anterior ocellus downward on each side of scrobal cavity to level of insertion of antennae, or nearly to that point; axilla with an elongate, generally fingerlike extension running posteriorly along lateral margin of scutellum (if somewhat triangular, then base of extension falling more or less distinctly below middle of axilla); surface of axillae above base of fingerlike extension more or less depressed or excavated..... 2
- Frons without such carina or at most with an indistinct one that extends laterad from ocellus for a short distance only; posterior extension of axilla not fingerlike but more or less triangular, its base extending to about middle or above middle of axilla; surface of axillae not depressed..... 9
2. Metallic-green, blue, or violaceous species; at least some of striae on cheeks continued uninterruptedly onto face; malar groove absent, although rarely faintly indicated; prepectus separated from pronotum by a very distinct suture; axillae usually in part smooth and shining (*hyalinus* group)..... 3
- Black species, occasionally in part greenish or bronzy; striae on cheeks very rarely continuous onto face; malar groove usually distinct; suture separating prepectus from pronotum indistinct; axillae opaque or subopaque, sometimes more or less shining at upper part (*platygaster* group)..... 5
3. Frons laterad of frontal carina with longitudinal rugae, without large punctures; ocellocular area with transverse rugae; viewed from in front, the frontal carina gradually approaching eye margin, its lower half nearly straight or at least not sharply curved; posterior orbit completely striated or with only a very narrow area smooth, the striae dense and numerous. Postocellar line at least about three times length of median line of vertex; scutellum as a rule about as long as mesoscutum and prothorax combined..... *hyalinus* Say
- Frons laterad of carina with large, shallow, irregular punctures, often more or less wrinkled also but without longitudinal rugae; ocellocular area with coarse punctures; viewed from in front, lower half of frontal carina sharply curved toward eye margin; broad area along posterior orbit smooth and striae on cheeks neither dense nor numerous..... 4
4. Postocellar line about twice length of median line of vertex, distinctly less than twice length of ocellocular line; emargination of frontovertex falling considerably in front of a line tangent to posterior margins of lateral ocelli; scutellum about as long as mesoscutum and prothorax together; head cupreous, face and scrobal cavity black, thorax violaceous to blue, antennal flagellum pale ferruginous..... *regalis*, new species

<sup>4</sup> Bull. Amer. Mus. Nat. Hist., vol. 23, art. 1, 1907.

<sup>5</sup> U. S. Dept. Agr., Bur. Ent. Tech. Ser. no. 19, pt. 4, 1912.

Postocellar line three or more times as long as median line of vertex, about twice length of ocellocular line; emargination of frontovertex almost touching a line tangent to posterior margins of lateral ocelli; scutellum produced at apex and as a rule distinctly longer than mesoscutum and prothorax together; head and thorax green, antennal flagellum grayish black.....

.....*carolinensis*, new species

5. Frontal scrobe above narrowly arcuate; distance between lateral ocellus and nearest point on frontal carina about equaling or exceeding shortest distance from that point on carina to anterior ocellus; if shorter (*platygaster* Say), then clypeus as a rule as long or about as long as wide..... 6

Frontal scrobe more broadly arcuate; distance between lateral ocellus and nearest point on frontal carina (or edge of emargination) shorter than shortest distance between that point on carina and anterior ocellus; if about equal (*carinifrons* Crawford), then face at side of clypeus smooth except for hair punctures..... 7

6. Shortest distance between lateral ocellus and frontal carina about equal to or shorter than shortest distance from that point in carina to anterior ocellus; if longer, then emargination of frontovertex touching a line tangent to anterior margins of lateral ocelli and postocellar line considerably longer than median line of vertex; area along inner margin of parapsides distinctly and completely or practically completely shagreened; walls between umbilicate punctures on mesoscutum thin, mere septa; clypeus as a rule about as long as wide.....*platygaster* Say

Shortest distance between lateral ocellus and frontal carina exceeding shortest distance from that point in carina to anterior ocellus; emargination of frontovertex falling distinctly in front of a line tangent to anterior margins of lateral ocelli and postocellar line not greatly longer than median line of vertex; area along inner margin of parapsides only in small part shagreened and that rather faintly so; walls between umbilicate punctures on mesoscutum widened or thickened, at least medially; clypeus very distinctly wider than long.....

.....*crawfordi*, new species

7. Area along inner margin of parapsides completely or practically completely sculptured, shagreened, or shagreened and aciculate; lateral ocelli distinctly depressed, vertex medially more or less distinctly elevated, this elevation continued diagonally in front of lateral ocelli; hyperclypeal area about as long as clypeus. Face at side of clypeus rugulose, rugulose granular, or granular; eyes with a vitreous surface.....*ocellatus*, new species

Area along inner margin of parapsides smooth or practically smooth and polished; lateral ocelli not depressed and vertex medially relatively not elevated, although rarely faintly so; hyperclypeal area distinctly shorter than clypeus..... 8

8. Face laterad of clypeus rugulose, rugose, or rugose-granular; frons laterad of frontal carina and ocellocular area very often distinctly sculptured; eyes with a dull surface; anterior margin of first tergite more or less distinctly emarginate.....*subcarinatus* Crawford
- Face laterad of clypeus, frons laterad of frontal carina, and ocellocular area smooth except for hair punctures; surface of



- eyes vitreous; anterior margin of first tergite apparently truncate-----*carinifrons* Crawford
9. First tergite, exclusive of invaginated anterior portion, very short, transversely linear or at least several times as broad as long, usually smooth or weakly sculptured and generally with anterior margin more or less elevated into a flangelike projection that masks more or less posterior aspect of neck of propodeum<sup>6</sup>; species with thorax usually in part metallic-----10
- First tergite more distinctly petioliform, rarely more than three times as broad as long, as a rule more or less rugosely sculptured and without a marginal flange anteriorly; species with thorax usually black (*fulvicornis* group)-----15
10. First tergite smooth and without an elevated anterior margin; frons meeting vertex in a sharp keel; area along inner margin of parapsides usually coarsely roughened with punctures or aciculations; insect as a rule in large part metallic. Scrobal cavity deep and wide, occupying practically whole of front and cutting a line tangent to anterior margins of lateral ocelli, its margins acutely angulated.  
*canadensis* Crawford and *canadensis nitidus*, new variety
- First tergite with anterior margin more or less distinctly elevated and often sculptured; frons meeting vertex in more or less of a curve; if meeting in a sharp keel, then insect black; area along inner margin of parapsides smooth or only finely sculptured or roughened-----11
11. Cheeks convexly rounded; head in front view, with very rare exceptions, distinctly transverse, not subtriangular; eyes reaching or about reaching level of base of clypeus; umbilicate punctures on mesoscutum and scutellum angulated and walls or interspaces thin, mere septa; only rarely are punctures round or roundish and interspaces thickened or widened; anterior margin of first tergite generally not completely masking posterior aspect of neck of propodeum, as a rule truncate or only slightly convex; head or thorax or both head and thorax sometimes black (*chrysopae* group)-----12
- Cheeks not convexly rounded but straight or nearly straight; head in front view usually elongate or somewhat transverse and as a rule subtriangular; eyes not reaching level of base of clypeus (not always so definite in males); umbilicate punctures on mesoscutum and scutellum round or roundish and interspaces more or less widened, at least medially; anterior margin of first tergite strongly elevated and completely masking posterior aspect of neck of propodeum, strongly or acutely convex; neither head nor thorax completely black (*anomocerus* group)-----14
12. Upper part of frons between eye and scrobal cavity usually vertically wrinkled or rugose, in males this sometimes extended to level of base of antennae; malar furrow half or less than half as long as width of cheek at apex; pronotum laterally as a rule very distinctly shorter than dorsal margin of prepectus; head very rarely completely black, usually more or less green, blue, bronzy, cupreous, or brown-----*chrysopae* Crawford

<sup>6</sup> Sometimes, as in *anomocerus* Crawford, extending and resting on neck of propodeum and appearing to form a petiolelike tergite.

- Upper part of frons smooth; malar furrow more than half as long as width of cheek at apex (rarely no more than half); pronotum laterally as long as dorsal margin of prepectus or not much shorter; head black, occasionally with some blue-green or bronzy reflections.....13
13. Frons meeting vertex in a curve; emargination of frontovertex acute or at least not markedly obtuse; anterior and posterior margins of prepectus carinate and gradually converging ventrally to form a single carina; scutellum not broadened apically, at most only slightly broader; thorax not completely black, notum at least greenish, bluish, bronzy, or cupreous (bright coloring sometimes very limited).....*rohweri*, new species
- Frons meeting vertex in a sharp keel; emargination of frontovertex markedly obtuse; carina along anterior margin of prepectus curved sharply caudad to meet posterior marginal carina at an approximate right angle at a point about half the distance between tegula and front coxa; scutellum more or less distinctly broadened apically; thorax black (punctate portion of notum sometimes bronzy black).....*capitatus*, new species
14. Third joint (ring joint) of antennae, except rarely, as long as wide; pronotum laterally as a rule no longer and generally not so long as dorsal margin of prepectus<sup>7</sup>; scutellum not granular laterad.....*anomocerus* Crawford
- Third joint of antennae wider than long; pronotum laterally longer than dorsal margin of prepectus; scutellum densely granular laterad.....*granulosus* Crawford
15. General color black with greenish and cupreous reflections; face and areas along inner margins of parapsides distinctly greenish; vertex and dorsum of thorax usually more or less cupreous; cheeks along malar furrow, frons, and face, exclusive of hyperclypeal area and clypeus, completely or in greater part finely and irregularly lineolate or aciculate. Cheeks convexly rounded; head in front view transverse.....*gahani*, new species
- General color black or blackish (head very rarely greenish and notum of thorax sometimes bronzy); front and face, except very rarely, entirely smooth except for hair punctures; cheeks along malar furrow usually smooth.....16
16. Angle formed by dorsal and anterior faces of pronotum laterally not sharp, the coarse punctation of sides of pronotum continued onto lateral margins of anterior face; punctate portion of pronotoprepectal area dorsally shorter than smooth portion; basal shallow furrow on underside of apex of scutellum not distinctly angled at middle; neck of propodeum weakly sculptured, only rarely coarsely sculptured.....17
- Angle formed by dorsal and anterior faces of pronotum sharp laterally as well as above, the coarse punctation of sides of pronotum not continued onto its anterior face; punctate portion of pronotoprepectal area dorsally as long or longer than smooth portion; basal shallow furrow on underside of apex of scutellum forming an acute angle medially or sometimes an obtuse angle; neck of propodeum coarsely sculptured, only rarely finely or weakly sculptured.....18

<sup>7</sup> The suture separating the prepectus from the pronotum may be indistinct.

17. Cheeks straight or nearly straight (sometimes convexly rounded in males); head somewhat, although only very slightly, transverse (at least in females), sometimes subtriangular; wings with a gray-brown or infuscated spot or cloud below marginal vein; scape in male broadened almost throughout whole length; small individuals, as a rule no more than about 2 mm long.....*stygius* Provancher
- Cheeks convexly rounded (sometimes only slightly so); head in front view with very rare exceptions distinctly transverse, not subtriangular; wings hyaline, although rarely with a faint indication of a cloud below marginal vein; male unknown; larger individuals, usually more than 2 mm in length.  
.....*fulvicornis prothracicus*, new variety
18. Cheeks convexly rounded (rarely almost straight); head in front view distinctly transverse, rarely nearly as long as broad and rarely subtriangular. Notum of thorax black (punctate portion sometimes bronzy); walls or interspaces between umbilicate punctures on mesoscutum and scutellum thin, mere septa, the punctures angulated.....*fulvicornis* Ashmead
- Cheeks straight or nearly straight; head in front view ranging from somewhat elongate to distinctly transverse, usually subtriangular.....19
19. Head in front view more or less distinctly transverse; punctate portion of notum of thorax, except rarely, bronzy or bronzy black; area along inner margin of parapsides as a rule with a greenish or bronzy tinge; interspaces between umbilicate punctures on mesoscutum or scutellum or on both, medially, usually slightly widened, punctures with more conspicuously thickened walls round or roundish.....*similis* Crawford
- Head somewhat elongate or only slightly transverse; notum of thorax black; area along inner margin of parapsides only very rarely greenish; walls or interspaces between umbilicate punctures on mesoscutum and scutellum thin, mere septa, punctures angulated.....20
20. Frons meeting vertex in more or less of a curve; emargination of frontovertex apparently never very pronounced\*; postmarginal vein usually distinctly longer than stigmal vein, its apex usually merging with darkish costal border of wing and indistinct; small individuals, thorax very distinctly less than 1.5 mm in length.....*muesebecki*, new species
- Frons meeting vertex in a more or less sharp keel; emargination of frontovertex usually conspicuous (best marked in males); postmarginal vein as a rule as long or only slightly longer than stigmal vein and usually clearly defined at apex; larger individuals, thorax about 1.5 mm long.....*robertsoni* Crawford

**PERILAMPUS CAROLINENSIS, new species**

*Female*.—Length about 4.5–5.5 mm. Head: Frons with a carina extending from behind the anterior ocellus downward on each side of the scrobal cavity to beyond the level of the insertion of the antennae, carina prominent and lower portion sharply curving toward eye margin; frons laterad of the carina with large, shallow, irregular

\* Head viewed dorsally.

punctures and also somewhat longitudinally wrinkled; ocellocular area with coarse punctures and some transverse wrinkles; emargination of frontovertex almost touching a line tangent to posterior margins of lateral ocelli and anterior margin of anterior ocellus only slightly in front of anterior margins of lateral ocelli; postocellar line three to four times the length of median line of vertex and practically twice the length of ocellocular line; eyes with a conspicuous smooth area along posterior orbit; cheeks and face on each side of clypeus with coarse or fairly coarse rugae (former very rarely in part smooth), the rugae well separated, neither dense nor numerous, lowermost ones on face commingling or continuous with those on cheeks, cheeks usually with more or less conspicuous punctures interspersed with the rugae; malar furrow absent, rarely very faintly indicated; hyperclypeal area strongly or rather strongly depressed in relation to face on each side; scrobal cavity deep, sides steep, beginning to flare at or about level of base of scape; clypeus wider than long, longer than hyperclypeal area, more or less conspicuously punctate, anterior margin very faintly arcuately emarginate medially, basal margin usually markedly concavely arcuate, face on each side immediately above rugae more or less conspicuously punctate; cheeks convexly rounded; head in front view distinctly transverse, eyes reaching more or less below level of base of clypeus.

Thorax: Scutellum produced at apex and as a rule distinctly longer than mesoscutum and prothorax together; areas along inner margins of parapsides more or less roughened with punctures and often also with aciculations; suture separating prepectus from pronotum very distinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of extension falling distinctly below middle of axilla, and the face of axilla depressed or excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter, surface of axilla as a rule in large part smooth and shining, with more or less conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad near middle of scutellum and running more or less parallel to each other to peripheral furrow; propodeum laterally depressed and rugose; walls between punctures on middle of scutellum more or less thickened, a small spot near center usually impunctate; wing veins long, postmarginal vein occupying about one-fourth to one-third the distance between the end of the marginal vein and the apex of the wing in a straight line and usually about three-fourths the length of the marginal vein; wing hairs rather dense.

Abdomen: Posterior face wider than long, as a rule very markedly wider; first tergite very strongly transverse, smooth or practically smooth and with no elevated anterior margin; hair punctures on second segment conspicuous.

**Color:** Head green, usually with violaceous or brassy reflections; vertex, front laterad of carina, temples, and hyperclypeal area rarely definitely brassy or cupreous; flagellum of antenna grayish black with apices sometimes reddish; scape concolorous with head; thorax green to violaceous-green, the axillae often brassy or with a brassy reflection; abdomen violaceous with green or greenish reflections; legs (outer faces at least) green; anterior tibiae in large part testaceous to brown, often with only a green stripe above; tarsi testaceous to pale reddish brown; wings hyaline, veins testaceous to brown.

**Male.**—Length about 3.5–4 mm. Essentially similar to female; differing largely in having the punctate portion of dorsum of thorax in large part bronzy or cupreous, the abdomen green or black with a blue-green reflection, and the intermediate tibiae sometimes in large part brown. Portion of scape bearing sensorial punctures fairly broad apically, and comprising somewhat over one-third to nearly one-half of scape, the sensoria rather fine and not dense.

**Type.**—U.S.N.M. no. 49777.

**Type locality.**—Rosslyn, Va.

**Remarks.**—Described from 18 females and 2 males. The type and allotype bear the following data: "Rosslyn, Va., Sept. 3, 1923, captured on thistle." Ten of the female paratypes and the one male paratype are also in the National Museum. Of these, two females bear the same data as the type; another is from Barcroft, Va. (Aug., J. C. Bridwell); five females were reared from *Anisota senatoria* Abbot and Smith (July, Aug., and Sept.) under the Melrose Highlands Laboratory no. 12431H1b and are from Mystic, Conn.; one female was reared from the same host species (Aug.) under the Melrose Highlands Laboratory no. 12431J2, and is from Bristol, Vt.; one female is from an unknown locality. The single male paratype was also reared from *A. senatoria* (July) under Melrose Highlands Laboratory no. 12431H2, and is from Elmira, N. Y. Of the remaining seven, one is in the collection of the Academy of Natural Sciences of Philadelphia from (?Pitman) New Jersey (Aug.); two are in the collection of the Melrose Highlands Laboratory—one from Southern Pines, N. C. (Sept., A. H. Manee), the other from Somerville, N. J., where it was reared by the writer (Aug. 25, 1924), under the laboratory no. 11744J2a, from *Datana integerrima* Grote and Robinson; and four are in the American Museum of Natural History in New York and were taken in the valley of the Black Mountains, N. C. (Aug. and Sept.), by W. Beutenmüller. The specimens reared from *Anisota* and *Datana* were likely hyperparasitic.

**PERILAMPUS REGALIS, new species**

**Female.**—Length about 3.5 mm. Head: Frons with a prominent carina extending from behind anterior ocellus downward on each side

of the scrobal cavity to beyond level of insertion of antennae, its lower portion sharply curving toward eye margin; ocellocular area and frons laterad of the carina conspicuously wrinkled and with rather large, shallow, irregular punctures; emargination of frontovertex falling considerably in front of a line tangent to the posterior margins of lateral ocelli, and anterior margin of anterior ocellus well in front of anterior margins of lateral ocelli; postocellar line twice or less than twice the length of median line of vertex, much less than twice the length of ocellocular line and sometimes only a little longer than the latter; eyes with a conspicuous smooth area along posterior orbit; cheeks and face on each side of clypeus with coarse ridges or rugae, the lowermost rugae on face commingling or continuous with those on cheeks, these rugae well separated, not dense and numerous; malar furrow absent; scrobal cavity deep, its sides beginning to flare somewhat above level of base of scape; hyperclypeal area rather strongly depressed in relation to face on each side; clypeus wider than long, longer than hyperclypeal area (sometimes nearly twice as long), its anterior margin shallowly but distinctly arcuate; cheeks convexly rounded; head in front view distinctly transverse; eyes reaching level of base of clypeus.

Thorax: Scutellum about as long as or not much longer than mesoscutum and prothorax together; area along inner margin of parapsides shallowly punctate and aciculate; suture separating prepectus from pronotum very distinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of extension falling distinctly below middle of axilla, face of axilla depressed or excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter, surface of axilla in large part smooth or practically smooth and shining but with more or less conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad and meeting in an acute angle on median line of scutellum; propodeum depressed laterad of the smooth median areas; scutellum with a conspicuous smooth median longitudinal line; walls between punctures on mesoscutum medially slightly thickened; wing veins long, the postmarginal vein occupying about one-fourth the distance between marginal vein and apex of wing in a straight line and about three-fourths the length of the marginal vein; wing hairs rather dense.

Abdomen: Posterior face very distinctly wider than long; first tergite very strongly transverse, apparently smooth and with no elevated anterior margin; hair punctures on second segment fairly conspicuous.

Color: Head, except face and scrobal cavity which are black, bright cupreous with a greenish reflection; hyperclypeal area cupreous to brassy; base of mandibles bluish to violaceous; flagellum of antenna

pale ferruginous; scape greenish; thorax violaceous to blue, anterior portion of prothorax blackish; abdomen black with a strong blue-green reflection and with a strong violaceous reflection beneath; legs (outer faces at least) more or less concolorous with thorax, anterior tibiae testaceous to brownish, sometimes with a violaceous stripe above, tarsi straw color to testaceous; wings hyaline, veins testaceous.

*Type*.—U.S.N.M. no. 49778.

*Type locality*.—Cadet, Mo.

*Remarks*.—Described from type and one female paratype. The latter is in the American Museum of Natural History; it is from Swannanoa Valley, N. C. (June). The type was taken by J. G. Barlow, June 19, 1889.

#### PERILAMPUS HYALINUS Say

*Perilampus hyalinus* SAY, Contr. MacLurian Lyc. Arts and Sci. Philadelphia, vol. 1, p. 79, 1829.—LECONTE, The complete writings of Thomas Say on the entomology of North America, vol. 1, p. 382, 1859.—VIERECK, Connecticut State Geol. Nat. Hist. Surv. Bull. 22, p. 524, 1916.

?*Perilampus hyalinus* PROVANCHER, Nat. Can., vol. 12, p. 293, 1881; Petite faune entomologique du Canada et particulièrement de la province de Québec, vol. 2, Hymén., p. 572, 1883.

?*Perilampus aciculatus* PROVANCHER, Additions et corrections au volume II de la faune entomologique du Canada traitant des Hyménoptères, p. 199, 1887.

*Female*.—Length about 2–5.5 mm. Head: Frons with a prominent carina extending from behind the anterior ocellus downward on each side of the scrobal cavity to level of insertion of antennae and beyond, its lower portion nearly straight or at least not very sharply curved, approaching eye margin gradually; frons laterad of carina with longitudinal rugae and ocellocular area with transverse rugae, the former area rarely smooth and in rare instances again marked with irregular ridges and coarse punctures, resembling the condition in *regalis*; emargination of frontovertex extending back between lateral ocelli, in some specimens almost touching a line tangent to posterior margins of same, anterior margin of anterior ocellus as a rule not much in front of anterior margins of lateral ocelli; postocellar line three to four times (sometimes more) the length of median line of vertex and distinctly longer than ocellocular line, often about twice as long; eyes without a smooth area along posterior orbit (striations often faint) or with such area narrow; cheeks and face on each side of clypeus with rather coarse rugae, the lowermost rugae on face commingling with or continuous with those on cheeks, the rugae on cheeks as a rule rather dense and numerous; malar furrow absent although rarely faintly indicated; scrobal cavity fairly deep, its sides beginning to flare considerably above level of base of scape, especially in the smaller specimens; hyperclypeal area, in relation to face, usually not greatly, sometimes not at all, depressed; clypeus wider than long (rarely almost as long as wide), somewhat longer than

hyperclypeal area, usually more or less conspicuously punctate, its anterior margin medially faintly arcuate and its basal margin sometimes markedly arcuate; face on each side immediately above rugose area usually conspicuously punctate; cheeks convexly rounded; head in front view usually distinctly transverse, eyes reaching to or below level of base of clypeus (the latter condition usually especially marked in the males).

Thorax: Scutellum, as a rule, of same length or only slightly longer than mesoscutum and prothorax together; area along inner margin of parapsides more or less roughened with punctures or aciculations or with both, the punctures usually shallow; suture separating prepectus from pronotum very distinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of this extension falling distinctly below middle of axilla; face of axilla more or less excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter; surface of axilla usually smooth or nearly smooth and shining, but with more or less conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially; propodeum laterally impressed and rugose; upper surface of scutellum rarely with a smooth median longitudinal line; wing veins usually long, postmarginal vein occupying about one-fifth to one-fourth the distance between the end of the marginal vein and the apex of the wing in a straight line and about two-thirds to three-fourths the length of marginal vein; wing hairs moderately to quite dense.

Abdomen: Posterior face usually wider than long, rarely longer than wide (more often so in the males); first tergite very strongly transverse and smooth or practically smooth and with no elevated anterior margin; hair punctures on second segment usually minute.

Color: Head green, blue, violaceous, or in some instances mostly blackish; vertex often brown or blackish and rarely brassy, front laterad of carina and the hyperclypeal area sometimes more or less brassy; flagellum of antenna grayish black to dark brown with tip and occasionally the whole underside reddish or brownish; scape more or less concolorous with head; thorax green, blue-green, blue, bluish black, or violaceous, very rarely with a brassy reflection; area along inner margin of parapsides often wholly or in part black or blackish and propodeum sometimes black, the median lobe of mesoscutum occasionally bronzy or cupreous; abdomen greenish, greenish violaceous, violaceous, or black, the green or blue-green reflection varying in strength and usually stronger on underside; legs (outer faces at least) more or less concolorous with head and thorax although sometimes more distinctly green; anterior tibiae largely testaceous or brownish except a stripe above; intermediate tibiae sometimes largely



brown; rarely with coxae, posterior tibiae, and all femora largely brown; tarsi more or less testaceous to brownish; wings hyaline, veins testaceous to brown, sometimes reddish basally.

*Male*.—Length about 2–4 mm. Essentially similar to female, differing largely as follows: Vertex and front laterad of carina often brassy, sometimes more or less cupreous, rarely the whole head with exception of scrobal cavity brassy or cupreous (resembling *regalis*); dorsum of thorax often almost entirely brassy or cupreous and rarely in larger part black or bronzy black; pleural region sometimes more or less brassy or with a brassy reflection; abdomen very rarely with some brassy or cupreous reflections; metallic stripe on anterior tibiae generally abbreviated toward apex and rarely altogether absent, intermediate and posterior tibiae quite consistently conspicuously pale at apex. Portion of scape bearing sensorial punctures moderately broad apically and comprising about one-third to nearly one-half of scape, the sensoria fine to coarse and dense or moderately dense.

*Type*.—Evidently lost. Redescribed from a very large series of specimens of both sexes.

*Distribution*.—This is perhaps the most common of our species. It occurs, evidently, throughout the United States and at least in southern Canada. I have seen material from 35 States, the District of Columbia, and 2 provinces in Canada, as follows: Maine (July, Aug.); New Hampshire (June); Massachusetts (May to Sept., incl.); Rhode Island (June); Connecticut (May); New York (June to Sept., incl.); New Jersey (May to Sept., incl.); Pennsylvania (July to Sept., incl.); Delaware; Maryland (May to Sept., incl.); Virginia (June to Sept., incl., “on thistle” and “*Ceanothus*”); North Carolina (June to Sept., incl.); Georgia (July); Florida (Jan.); Michigan (July); Indiana; Alabama (Apr.); Wisconsin (July); Illinois (July); Minnesota (June, July); Iowa (July); South Dakota (July); Nebraska (June, July); Kansas (June, Sept.); Texas (June, July, Dec.); Montana (Aug.); Wyoming; Colorado (June, 6,000 to 7,000 feet; July, “on hop”; Aug.); New Mexico (“on *Populus*”); Idaho (June); Utah (July); Arizona; Washington (July); Oregon; California (May to July, incl., Nov.); District of Columbia (June, July); Nova Scotia (Aug., Sept.); Ontario (July).

*Hosts*.—*Compsilura concinnata* Meigen; *Ernestia ampelus* Walker; ?*E. ruficauda* (Brauer); *Achaetoneura euchaetiae* Webber; *A. melalophae* Allen; “tachinid puparium”; *Eulimneria valida* Cresson; *Eulimneria* sp.; *Apanteles hyphantriae* Riley; *A. melanoscelus* Ratzeburg; *Meteorus hyphantriae* Riley. I find also the following hosts recorded: “*Diprion* cocoon”; “*Hyphantria cunea* Drury”; and “*Euchaetias egle* Drury”, but the real host was very likely some parasite attacking these.

## PERILAMPUS PLATYGASTER Say

*Perilampus platigaster* SAY, Boston Journ. Nat. Hist., vol. 1, p. 274, 1836.—

LeCONTE, The complete writings of Thomas Say on the entomology of North America, vol. 2, p. 722, 1859.

?*Perilampus platygaster* PROVANCHER, Petite faune entomologique du Canada et particulièrement de la province de Québec, vol. 2, Hymén., p. 572, 1883.—

VIERECK, Connecticut State Geol. Nat. Hist. Surv. Bull. 22, p. 524, 1916.

*Female*.—Length about 2.5–3.5 mm. Head: Frons with a prominent carina extending from behind the anterior ocellus downward on each side of the scrobal cavity to or beyond level of insertion of antennae, sometimes reaching nearly to level of ventral margin of eye; frons laterad of carina and ocellocular area usually in large part distinctly shagreened; emargination of frontovertex narrowly arcuate and not widening rapidly downward, the distance between lateral ocellus and nearest point on carina about equal to or shorter than the shortest distance from this point to anterior ocellus, when longer usually not considerably so; apex of emargination touching or slightly cutting line tangent to anterior margins of lateral ocelli; postocellar line distinctly or considerably longer than median line of vertex (not so pronounced in the males); scrobal cavity deep, its sides sloping steeply, the steep slope continued more or less to level of base of clypeus so that hyperclypeal area appears relatively considerably depressed; eyes with a dull surface; face at sides of clypeus rugulose or rugose or rugose-granular (usually coarsely granular); malar furrow present but sometimes weak and rarely, in the males at least, practically absent or merely indicated; clypeus as a rule about as long as wide and about one and one-half times to nearly twice as long as hyperclypeal area (in one male more than twice as long), anterior margin of clypeus medially faintly arcuate, the basal margin usually slightly arcuate; cheeks convexly rounded, the striae on same not crossing malar furrow onto face; head in front view transverse; eyes reaching to or below level of base of clypeus (latter condition generally more pronounced in the males).

Thorax: Walls between umbilicate punctures on mesoscutum and scutellum thin, mere septa (on the latter sometimes slightly thickened along median longitudinal line); area along inner margin of parapsides distinctly and completely or practically completely shagreened; suture separating prepectus from pronotum indistinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of this extension falling more or less distinctly below middle of axilla; face of axilla more or less excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter; surface of axilla completely or practically completely sculptured and opaque or subopaque and as a rule without very conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum

turning caudad medially; outer portion of mediolateral areas of propodeum as a rule not depressed although sometimes marked with coarse rugae, as a rule not differing materially from greater part of surface; postmarginal vein occupying about one-sixth or less than one-sixth the distance between end of marginal vein and apex of wing in a straight line, about one-half to nearly two-thirds the length of marginal vein<sup>2</sup>; wing hairs fairly or quite dense and usually dark, rarely rather pale.

Abdomen: Posterior face wider than long, sometimes about as long as wide; first tergite strongly transverse and more or less sculptured, its anterior margin not, or rarely, slightly elevated and as a rule more or less distinctly emarginate; third segment (second of the gaster) concealed or only slightly exposed.

Color: Black; flagellum of antenna grayish dull dark brown to grayish reddish brown with apical portion paler, the paler color usually more extensive on underside and in some specimens taking in the whole of the underside; scape as a rule bluish or greenish; legs brown to blackish brown; coxae usually black; posterior femora as a rule bluish or greenish, anterior and intermediate femora also sometimes greenish or bluish; posterior and intermediate tibiae apically and anterior tibiae, except a stripe at base above, pale testaceous to brownish, the basal portion of posterior pair sometimes with a bluish or greenish tinge; in males all tibiae sometimes completely testaceous; tarsi straw color to testaceous or brownish testaceous; wings hyaline, veins dull yellowish to brownish, sometimes reddish basally.

*Male*.—Length about 2.25–3 mm. Essentially the same as the female; scape slender, the portion bearing sensorial punctures not very greatly broadened at apex and comprising nearly the whole length of the scape, sensoria fine to moderately coarse and dense.

*Type*.—Evidently lost. Redescribed from 12 females and 9 males.

*Distribution*.—Massachusetts (July); New Jersey (July); Pennsylvania; Maryland (July, Sept.); District of Columbia; Virginia (May, Aug., Sept.); Illinois. Say described the species from Indiana.

The species has been reared from a pupa of *Melittia*, but very likely it was hyperparasitic.

PERILAMPUS CRAWFORDI, new species

*Female*.—Length about 2.5–3 mm. Head: Frons with a carina extending from behind the anterior ocellus downward on each side of the scrobal cavity to beyond the level of the insertion of the antennae, this carina prominent or fairly prominent; frons laterad of carina and ocellocular area usually in part faintly shagreened (sometimes more distinct in males); emargination of frontovertex narrowly arcuate and slowly widening downward; the distance

<sup>2</sup> The posterior limit of the postmarginal vein is often rather difficult to make out, the vein merging with the costal border of the wing.

between lateral ocellus and nearest point on carina very distinctly exceeding shortest distance from this point on carina to anterior ocellus, apex of emargination falling distinctly in front of a line tangent to anterior margins of lateral ocelli; postocellar line equal to or not greatly exceeding median line of vertex; scrobal cavity deep, its sides sloping steeply and steep slope continued more or less to level of base of clypeus so that hyperclypeal area appears relatively depressed; eyes with a dull surface; face at side of clypeus rugulose or rugose-granular or rather coarsely granular; malar furrow present but sometimes weak; clypeus very distinctly wider than long and about one and one-half times as long as hyperclypeal area, its anterior margin medially truncate or practically truncate, its basal margin usually faintly arcuate; cheeks convexly rounded, the striae on same not crossing malar furrow onto face; head in front view more or less transverse, eyes reaching level of base of clypeus (in some males reaching distinctly below).

Thorax: Walls between umbilicate punctures on mesoscutum and scutellum, at least along the median line, distinctly thickened and reticulated (not always so distinctly in the males), the interspaces elsewhere also conspicuously sculptured; punctures on mesoscutum and scutellum round or roundish; area along inner margin of parapsides in part usually weakly shagreened or aciculate; suture separating prepectus from pronotum sometimes distinct; axilla with an elongate fingerlike extension running posteriorly along the lateral margin of the scutellum, the base of this extension falling more or less distinctly below middle of axilla; face of axilla more or less depressed or excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter; surface of axilla completely sculptured and opaque or subopaque and without conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially; outer portion of mediolateral areas of propodeum usually neither depressed nor differing materially in sculpture from surface as a whole; postmarginal vein occupying about one-sixth or less than one-sixth the distance between end of marginal vein and apex of wing in a straight line, about one-half the length of marginal vein<sup>10</sup>; wing hairs quite dense and dark.

Abdomen: Posterior face wider than long or about as long as wide; first tergite strongly transverse and usually in part sculptured, its anterior margin not or but slightly elevated, truncate or practically so, sometimes appearing as if shallowly and broadly arcuate, at least in the males; third segment (second of the gaster) usually not exposed, rarely slightly so.

<sup>10</sup> The posterior limit of the postmarginal vein is sometimes rather difficult to make out, the vein merging with the costal border of the wing.

Color: Black; flagellum of antenna grayish dull dark brown with extreme apex usually paler, pale area sometimes more extensive beneath; scape bluish or greenish; legs brown; coxae blackish brown, the posterior pair often with a greenish, bluish, or violaceous reflection; posterior femora outwardly greenish, bluish, or violaceous, or with such reflections, anterior and intermediate pairs sometimes with such reflections; anterior tibiae testaceous to brown with a darker stripe above, intermediate and posterior pairs also darker above, the outer face of posterior usually, and of intermediate sometimes, with a bluish or greenish reflection; tarsi testaceous to brownish; wings hyaline, veins testaceous to brown, sometimes reddish basally.

*Male*.—Length about 2.5–3 mm. Essentially similar to female; scape slender, portion bearing sensorial punctures not greatly broadened at apex and occupying one-half or somewhat less than one-half of scape, sensoria coarse and dense.

*Type*.—U.S.N.M. no. 49781.

*Type locality*.—Glencarlyn, Va.

*Remarks*.—The type and allotype were taken, respectively, in June and July.

Described from four females and five males. Of the three female paratypes, one, from Van Cortland, N. Y. (July, J. L. Zabriskie), is in the American Museum of Natural History; one, from Swarthmore, Pa. (July), is in the Academy of Natural Sciences of Philadelphia; and the third (in rather poor condition), from Riverton, N. J. (Aug., C. W. Johnson), is in the collection of the Boston Society of Natural History. Of the four male paratypes, one, from Laurel, Md. (July, E. B. Marshall), is in the U. S. National Museum; one, from Falls Church, Va., and another, from Laurel, Md. (July, E. B. Marshall), are in the Museum of Comparative Zoology; and one, from Glencarlyn, Va. (July), is in the collection of Prof. C. T. Brues, of Harvard University.

#### PERILAMPUS SUBCARINATUS Crawford

*Perilampus subcarinatus* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 70, 1914.

*Perilampus bakeri* CRAWFORD, *ibid.*, p. 72.

*Female*.—Length about 2.5–3.75 mm. Head: Frons with a carina extending from behind the anterior ocellus downward on each side of the scrobal cavity nearly to level of insertion of antennae or beyond, the carina sometimes delicate; frons laterad of carina and ocellular area sometimes smooth, sometimes distinctly sculptured (the sculpturing more common and usually more conspicuous in males); emargination of frontovertex broadly or rather broadly arcuate; the distance between lateral ocellus and nearest point on carina as a rule distinctly or considerably shorter than shortest distance from this point on carina to anterior ocellus; emargination touching or nearly

touching a line tangent to anterior margins of lateral ocelli; postocellar line very distinctly longer than median line of vertex, sometimes more than twice as long (not so distinctly so in the males), usually about twice as long as ocellocular line; lateral ocelli not depressed and vertex medially not elevated; sides of scrobal cavity<sup>11</sup> not very steep (usually steeper in males) and face at side of hyperclypeal area quite strongly flaring, the hyperclypeal area relatively not at all or but slightly depressed; eyes with a dull surface; face at sides of clypeus finely rugulose, or rugose-granular, this sculpture sometimes extending above level of base of clypeus; malar furrow present but sometimes faint (in the males, rarely, practically absent); clypeus distinctly wider than long and distinctly longer than hyperclypeal area, its anterior margin medially broadly and shallowly arcuate to practically truncate, basal margin weakly to quite distinctly arcuate; cheeks convexly rounded, the striae on same usually not crossing malar furrow onto face; head in front view more or less transverse, eyes reaching or about reaching level of base of clypeus (generally reaching distinctly beyond in the males).

Thorax: Mesoscutum and scutellum coarsely punctate, the walls between punctures on prothorax as a rule in large part widened; area along inner margin of parapsides smooth or practically smooth and polished; suture separating prepectus from pronotum as a rule indistinct; axilla with an extension running posteriorly along lateral margin of scutellum, this extension sometimes not much longer than wide, its base falling more or less distinctly below middle of axilla; face of axilla more or less depressed or excavated immediately above base of extension, the portion immediately anterior to extension not sloping toward latter; surface of axilla completely sculptured and opaque or subopaque, the upper part sometimes rather finely sculptured and shining, usually without very conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially; outer portion of medio-lateral areas of propodeum usually not depressed, sometimes with coarse or conspicuous rugae but usually not differing materially from greater part of surface, the surface adjacent to median carina usually excavated and rugulose; postmarginal vein occupying about one-sixth or less than one-sixth the distance between end of marginal vein and apex of wing in a straight line, sometimes not much longer than stigmal vein, slightly less than one-half to nearly two-thirds the length of marginal vein, the end distinctly visible; wing hairs rather short and not dense, mostly pale but with some darker hairs on apical portion of wing (in the males the apex of postmarginal vein sometimes indistinct and the hair of the entire wing sometimes dark and longer).

<sup>11</sup> In the broad sense, the portion included between the carinae.

Abdomen: Posterior face as long as or distinctly longer than wide; first tergite strongly transverse and as a rule more or less sculptured, its anterior margin more or less elevated and more or less distinctly emarginate; third segment (second of the gaster) considerably exposed.

Color: Head black, very often wholly or in large part metallic black and sometimes in part greenish black; vertex, front laterad of carina, clypeus, and hyperclypeal area sometimes bronzy; thorax black to metallic black, the notum sometimes in part bronzy black and the areas along inner margins of parapsides sometimes greenish; abdomen black or gray metallic black; flagellum of antenna grayish dull dark brown to grayish reddish brown, usually paler apically, the pale color more extensive beneath and sometimes embracing the whole lower surface; scape black, sometimes with a greenish reflection; legs brown; coxae generally blackish brown; anterior and posterior femora outwardly sometimes blackish brown but usually with a greenish, bluish, or violaceous tinge and sometimes markedly green; anterior and intermediate tibiae usually testaceous or approaching testaceous, with a darker stripe above which may have a distinct green or blue-green reflection; posterior tibiae sometimes with a very distinct green reflection; tarsi testaceous or reddish testaceous; wings hyaline, veins testaceous to brown.

*Male*.—Length about 2.5–3.5 mm. Essentially similar to female; scape stout, the part bearing sensorial punctures conspicuously thickened or broadened and occupying distinctly more than one-half to three-fourths of scape, the sensoria rather fine to moderately coarse and dense.

*Type*.—U.S.N.M. no. 18298. The type of *bakeri* is also in the National Museum (no. 18301).

*Remarks*.—Redescribed from 19 females and 22 males, including the type series of the species and also of the synonym *bakeri* Crawford. A study of the types and paratypes of *subcarinatus* and *bakeri* in connection with additional material available for study indicates that the two are identical. I have, therefore, suppressed *bakeri* as a synonym.

*Distribution*.—Alabama (Aug.); Louisiana (Sept.); Texas (May, July, Oct.); Nebraska (July); Colorado, 3,700–5,100 feet (Aug.); Idaho (June to Aug., incl.); California (May).

PERILAMPUS CARINIFRONS Crawford

*Perilampus carinifrons* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 71 1914.

*Female*.—Length about 1.75–3.25 mm. Head: Frons with a carina extending from behind the anterior ocellus downward on each side of the scrobal cavity to or beyond the level of insertion of antennae, the

carina usually not very prominent; frons laterad of carina and ocellular area smooth; emargination of frontoververtex as a rule rather broadly arcuate, the distance between lateral ocellus and nearest point on carina, or edge of emargination, shorter than shortest distance from this point on carina to anterior ocellus, sometimes about equal; emargination touching or nearly touching line tangent to anterior margins of lateral ocelli; postocellar line distinctly longer than median line of vertex; lateral ocelli not depressed and vertex medially not distinctly elevated although sometimes faintly so; sides of scrobal cavity<sup>12</sup> not sloping very sharply (sometimes steeper in males) and face at side of hyperclypeal area strongly flaring, the hyperclypeal area relatively not depressed or but slightly so; eyes with a vitreous surface; face at side of clypeus smooth except for hair punctures, sometimes weakly sculptured along outer edge; malar furrow present but may be indistinct; clypeus distinctly wider than long and distinctly longer than hyperclypeal area, its anterior margin medially usually faintly arcuate and the basal margin not at all or only very slightly arcuate; cheeks convexly rounded, the striae on same not crossing malar furrow onto face; head in front view transverse, eyes reaching or nearly reaching level of base of clypeus.

Thorax: Walls between punctures on prothorax sometimes distinctly widened; mesoscutum very often in part at least rugosopunctate; area along inner margin of parapsides smooth; suture separating prepectus from pronotum indistinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of this extension falling below middle of axilla, face of axilla more or less depressed or excavated immediately above base of extension and the portion immediately anterior to extension not sloping toward latter; surface of axilla completely sculptured and opaque or subopaque, the upper part sometimes more finely sculptured and shining, usually without very conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially; outer portion of mediolateral areas of propodeum not depressed and not differing materially from greater part of surface, slightly excavated adjacent to median carina; postmarginal vein occupying one-sixth or much less than one-sixth the distance between end of marginal vein and apex of wing in a straight line and about one-half or somewhat more than one-half the length of the marginal vein; wing hairs fairly dense and mostly dark.

Abdomen: Posterior face somewhat shorter than broad to longer than broad; first tergite strongly transverse and more or less sculptured, its anterior margin usually more or less elevated and truncate or apparently truncate; third segment (second of the gaster) more or less exposed.

<sup>12</sup> In the broad sense, the portion included between the carinae.



Color: Black, area along inner margin of parapsides sometimes greenish or gray metallic black; flagellum of antenna grayish dull dark brown to grayish reddish brown, usually paler at apex and on the whole of the underside; scape black, sometimes in part brown and in some instances with a greenish reflection; coxae black or blackish; femora outwardly usually dark brown or blackish brown, the anterior and intermediate pairs usually with a bluish or greenish tinge and posterior pair usually very distinctly greenish or bluish; tibiae brown, anterior usually more or less testaceous except for a stripe above, posterior usually with a greenish or violaceous tinge or reflection; tarsi straw color to testaceous; wings hyaline, wing veins testaceous to brown, sometimes reddish basally.

*Male*.—Length about 2–2.25 mm. Essentially like the female; scape slender, portion bearing sensorial punctures not greatly broadened apically and occupying two-thirds or somewhat more than two-thirds of scape, sensoria rather fine and dense.

Species characterized by smoothness of head.

*Type*.—U.S.N.M. no. 18300.

*Remarks*.—Redescribed from eight females and three males, including type, allotype, and paratypes; all from Texas (Jan., May, June, Sept., Oct.). Nine of the specimens are in the United States National Museum; one is in the American Museum of Natural History, and one in the collection of Prof. C. T. Brues, of Harvard University.

**PERILAMPUS OCELLATUS, new species**

*Female*.—Length about 3–3.25 mm. Head: Frons with a carina extending from behind anterior ocellus downward on each side of scrobal cavity to beyond level of insertion of antennae, this carina not very prominent, sometimes masked by sculpturing of head and occasionally altogether absent behind anterior ocellus; frons laterad of carina and ocellocular area weakly to distinctly sculptured, shagreened or irregularly rugulose; emargination of frontovertex broadly or rather broadly arcuate, the distance between lateral ocellus and nearest point in edge of emargination considerably shorter than shortest distance from this point to anterior ocellus, emargination nearly reaching line tangent to anterior margins of lateral ocelli; postocellar line longer than median line of vertex; lateral ocelli distinctly depressed, the vertex medially more or less distinctly elevated and this elevation continued diagonally in front of lateral ocelli; upper margin of anterior ocellus usually falling markedly below anterior edge of vertex and the ocelli sometimes noticeably small for size of insect; sides of scrobal cavity distinctly shagreened or rugulose, not sloping very sharply; face at side of hyperclypeal area quite strongly flaring, the hyperclypeal area relatively not depressed or but slightly so; eyes with a vitreous surface; face at side of clypeus

rugulose or rugulose-granular; malar furrow usually distinct; clypeus distinctly wider than long and hyperclypeal area about as long as clypeus; anterior margin of clypeus medially truncate or practically truncate, basal margin straight or slightly convex; cheeks convexly rounded, the striae on same not crossing malar furrow onto face; narrow area along posterior orbit sometimes very finely and densely sculptured; head in front view more or less transverse; eyes reaching about to level of base of clypeus.

Thorax: Mesoscutum and scutellum with the interspaces between umbilicate punctures conspicuously reticulately sculptured, the interspatial wall along median longitudinal line of scutellum slightly thickened; area along inner margins of parapsides very finely sha-greened; suture separating prepectus from pronotum indistinct; axilla with an elongate fingerlike extension running posteriorly along lateral margin of scutellum, the base of this extension falling distinctly below middle of axilla, the axilla more or less depressed or excavated immediately above base of extension and with the portion immediately anterior to extension not sloping toward latter; surface of axilla completely sculptured and opaque or subopaque, and without conspicuous rugae immediately above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially; mediolateral areas of propodeum finely rugulose sculptured, not depressed laterally but sometimes excavated more or less on each side of the median carina; postmarginal vein occupying about one-sixth or less than one-sixth the distance between end of marginal vein and apex of wing in a straight line and about one-half to nearly two-thirds the length of the marginal vein; wing hairs fairly dense and dark.

Abdomen: Posterior face somewhat broader than long to longer than broad; first tergite strongly transverse and usually more or less sculptured, its anterior margin more or less elevated and apparently truncate; third segment (second of the gaster) more or less distinctly exposed.

Color: Black; flagellum of antenna grayish black to grayish reddish brown, paler at apex and beneath; the scape black or blackish brown; legs brown; coxae black; anterior and posterior femora outwardly dark brown or blackish with a bluish or greenish tinge, posterior femora usually distinctly green; anterior tibiae more or less testaceous with a darker stripe above, posterior tibiae often with a bluish or greenish tinge; tarsi testaceous or reddish testaceous; wings hyaline, veins yellow-brown to brown.

*Male*.—Length about 2.75–3.25 mm. Essentially the same as the female; scape slender, part bearing sensorial punctures not greatly broadened at apex and occupying more than one-half to about two-thirds of scape, sensoria fairly coarse and dense.

*Type*.—U.S.N.M. no. 49782.

*Type locality*.—Missouri.

*Remarks.*—Described from two females and three males. The type is labeled "C. Mo., July" and the allotype "Ashmead." The female and the two male paratypes are from Georgia, one of the males from Chickamauga (June), and are in the collection of the Academy of Natural Sciences of Philadelphia.

**PERILAMPUS CANADENSIS** Crawford

*Perilampus canadensis* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 74, 1914

*Female.*—Length about 3–4.5 mm. Head: Frons meeting vertex in a sharp angle but without a carina; emargination of frontovertex deeply and widely angulated and cutting a line tangent to anterior margins of lateral ocelli, anterior margin of anterior ocellus usually not far in front of that of lateral ocellus; scrobal cavity deep and wide, its sides sloping more or less sharply, the slope usually continued more or less on each side of hyperclypeal area and latter may appear relatively depressed; ocellocular area and upper part of front between eye and scrobal cavity usually with large and very shallow pits surrounding hair punctures; face along and below malar furrow with prominent punctures; clypeus wider than long and more or less longer than hyperclypeal area; cheeks convexly rounded and smooth except for hair punctures; head in front view transverse; eyes reaching to or beyond level of base of clypeus.

Thorax: Robust; area along inner margins of parapsides usually roughened with rather coarse punctures and aciculations; suture separating prepectus from pronotum distinct; axilla with a triangular extension as wide as or wider than long on side of scutellum, its base extending above middle of axilla, the face of axilla not depressed or excavated above base of extension and sloping toward base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially but meeting to form a more or less continuous curve; wing veins usually long; wing hairs as a rule long and coarse.

Abdomen: Posterior face usually wider than long, sometimes as long as wide; first tergite very strongly transverse and smooth, its anterior margin not elevated; third segment (second of the gaster) considerably exposed.

Color: Black; notum of thorax more or less bronzy; the area along inner margin of parapsides often bright bronzy, sometimes approaching cupreous; ocellocular area (sometimes the whole of vertex) and upper part of front between eye and scrobal cavity usually somewhat bronzy, the cheeks also sometimes bronzy; temples, cheeks, and hyperclypeal area sometimes greenish; flagellum of antenna grayish black or grayish dull dark brown, usually obscurely ferruginous at apex and sometimes ferruginous on the whole of the underside; scape concolorous with head, sometimes distinctly greenish; legs brown,

coxae usually blackish, hind femora dark brown or black and usually with a blue or green luster, anterior femora usually blackish brown with a blue luster, anterior tibiae in large part pale brown or testaceous and usually with a darker stripe above, intermediate tibiae darker above, and posterior pair in part blackish brown with a blue or green luster; tarsi testaceous or reddish testaceous; wings hyaline, veins as a rule light brown or reddish brown.

*Male*.—Length about 2.5–3.5 mm. Similar to female; part of scape bearing sensorial punctures fairly broad apically and occupying one-half or somewhat less than one-half of scape, the sensoria fairly coarse and not very dense.

*Type*.—U.S.N.M. no. 18306.

Redescribed from 15 females and 8 males, including type and allotype. Eight specimens are in the United States National Museum and 12 of the others in the Museum of Comparative Zoology.

*Distribution*.—Pennsylvania (July); Maryland (July); Virginia (June, July, Aug.); Louisiana; Minnesota (June); "Canada."

*Host*.—*Zenillia* (*Exorista*) sp.; another record reads "reared with *Macremphytus*", but the host in this case was probably some parasite.

PERILAMPUS CANADENSIS NITIDUS, new variety

*Female*.—Length about 3–3.5 mm. Differs from *canadensis* Crawford in the following respects: Head bright cupreous or with the vertex and front between eye and scrobal cavity bright cupreous and the temples and cheeks and more or less of the remainder of head greenish; antennal scape metallic (the flagellum missing); punctures of thorax unusually deep and coarse, the interspaces more or less cupreous, the bottoms of pits bluish; areas along inner margins of parapsides bright cupreous; legs sometimes in part violaceous; abdomen sometimes green; mesoscutum usually markedly convex; angle formed by front and vertex sometimes not well marked or sharp outside of ocellar region and emargination of frontovertex only moderately wide; ocellocular area and front between eye and scrobal cavity without large shallow pits or with such pits very faint; face along malar furrow as a rule not conspicuously punctured; eyes sometimes not reaching level of base of clypeus.

*Male*.—Length about 2.5 mm. Similar to female except that areas along inner margins of parapsides may be brassy green; flagella of antennae ferruginous or obscurely ferruginous. Part of scape bearing sensorial punctures not greatly broadened apically and occupying about one-third the length of the scape, sensoria rather fine to fairly coarse.

*Type*.—U.S.N.M. no. 49784.

*Type locality*.—New Jersey.

*Remarks.*—Described from three females and two males. The type, labeled "N. J. 2057, collection C. F. Baker", and the allotype, "Pa. 2216, collection C. F. Baker", and a female and the male paratype, both from Louisiana, also from the Baker collection and bearing, respectively, nos. 2337 and 2335, are in the United States National Museum collection. The other female paratype, from Falls Church, Va. (Aug.), is in the Museum of Comparative Zoology.

**PERILAMPUS CHRYSOPAE** Crawford

*Perilampus chrysopae* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 73, 1914.

*Perilampus chrysopae* var. *laevicephalus* CRAWFORD, Insecutor Inscitiae Menstruus, vol. 4, p. 144, 1916.

*Female.*—Length about 1.5–3 mm. Head: Frons without a carina, meeting vertex in more or less of a curve, upper part of frons between eye and scrobal cavity usually wrinkled or rugose (in males the sculpture sometimes extending to base of antennae) and ocellocular area often similarly sculptured; anterior ocellus cutting or nearly cutting line tangent to anterior margins of lateral ocelli, the anterior margin of anterior ocellus usually not far in front of anterior margins of lateral ocelli; malar furrow, with rare exceptions, half or less than half the width of cheek at apex; cheeks convexly rounded; head in front view distinctly transverse, rarely somewhat subtriangular; eyes reaching to or beyond level of base of clypeus (latter condition generally more marked in the males).

Thorax: More or less robust; area along inner margin of parapsides smooth or only very weakly sculptured, occasionally with some fairly prominent punctures; umbilicate punctures on mesoscutum and scutellum large and somewhat angulated, the interspaces thin, mere septa, rarely with the interspaces widened and punctures round or roundish; scutellum usually broadened apically and usually more or less conspicuously emarginate at apex; pronotum laterally usually very distinctly shorter than dorsal margin of prepectus; axilla with a triangular or roughly triangular extension as wide as or wider than long on side of scutellum, its base extending above middle of axilla; surface of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially but meeting to form a continuous gently curved furrow, very rarely forming a slight angle medially; postmarginal vein relatively rather long, sometimes about as long as marginal vein.

Abdomen: Posterior face as wide as or wider than long (in the males frequently longer than wide); first tergite strongly transverse, smooth or only weakly sculptured, its anterior margin usually more or less

elevated and truncate or only slightly convex, and only partially masking posterior aspect of neck of propodeum.

Color: Ranging from distinctly metallic to nearly black; head dark metallic green to nearly black, sometimes with a cupreous tinge above; flagellum of antenna grayish black to entirely pale ferruginous, frequently with the apex and under side paler than the rest; scape usually concolorous with head; dorsum of thorax dark green, greenish, or bluish, sometimes with a cupreous or bronzy cast and rarely quite dark or blackish, the areas along inner margins of parapsides usually distinctly metallic green but occasionally nearly black; abdomen black or black with greenish reflections, sometimes distinctly green; legs dark brown or blackish, the hind femora sometimes and more rarely all of the femora as well as the hind tibiae with greenish or bluish reflections; anterior tibiae testaceous or reddish testaceous, sometimes with a dark stripe above; tips of intermediate and hind tibiae usually testaceous, the latter often so at base; tarsi testaceous or reddish testaceous; wings hyaline, veins testaceous to brown.

*Male*.—Length about 1.5–2.5 mm. Similar to female; front between eye and scrobal cavity usually more strongly wrinkled and emargination of frontovertex usually more sharply pronounced; part of scape bearing sensorial punctures variable, slightly to very distinctly broadened apically and occupying from somewhat over one-third to two-thirds of scape, sensoria very fine to moderately coarse.

*Type*.—U.S.N.M. no. 20822.

The type of *laevicephalus* is in the same collection.

Redescribed from a large series of specimens of both sexes, including types, allotypes, and paratypes.

*Distribution*.—Widely distributed. I have seen material from "Canada" and the District of Columbia (Sept., Oct.), and from the following States: Maine (July, Aug.); New Hampshire; Vermont (June); Massachusetts (July, Aug.); Rhode Island (June); New York; New Jersey (Aug.); Pennsylvania; Maryland; Virginia (Aug., Oct.); North Carolina (Aug., Sept.); South Carolina (Sept.); Michigan; Indiana (July); Alabama; Wisconsin (July); Illinois; Mississippi (Aug.); South Dakota; Kansas (Sept.); Oklahoma (April, Sept. "on *Eupatorium serotinum*"); Texas (May, July, Aug.); Montana (Aug.); Wyoming (July); Colorado (Sept.); Idaho (Aug.); Nevada (July); Washington (May, July); Oregon; California (Sept.).

*Hosts*.—*Chrysopa* spp. One of these is *Chrysopa californica* Coquillett; another record reads "Ex *Chrysopa* cocoon collected on cotton." According to Essig,<sup>13</sup> the species is also a primary parasite of *Symphrophobius angustus* (Banks), the slender brown lacewing, and related species in California.

<sup>13</sup> Insects of western North America, p. 849, 1926.

**PERILAMPUS ROHWERI, new species**

*Female*.—Length about 2–3 mm. Head: Frons without a carina, meeting vertex in a curve; emargination of frontovertex subacute or not markedly obtuse; ocellocular area and front between eye and scrobal cavity smooth (rarely, in the males at least, in part faintly wrinkled); malar furrow more than half the width of cheek at apex; clypeus wider than long and usually longer than hyperclypeal area; cheeks convexly rounded and smooth; head in front view more or less distinctly transverse; eyes reaching or about reaching level of base of clypeus.

Thorax: Area along inner margin of parapsides smooth; umbilicate punctures on mesoscutum and scutellum angulated, the interspaces thin, although here and there and especially at base of scutellum a wall may be thickened; scutellum not or at most only slightly broadened apically; pronotum laterally as long as or not much shorter than dorsal margin of prepectus, the margins of latter converging ventrally into a single carina; axilla with a triangular or roughly triangular extension on side of scutellum, this extension as wide as or wider than long and with its base extending above middle of axilla, the face of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially but meeting to form a single gently curved furrow, rarely meeting at a slight angle; postmarginal vein about three-fourths or more than three-fourths the length of the marginal vein.

Abdomen: Posterior face broader than long or as long as broad; first tergite strongly transverse, smooth, its anterior margin only slightly elevated, and truncate or nearly truncate, sometimes partially masking posterior aspect of neck of propodeum; third segment (second of the gaster) not exposed (may be somewhat so in the males).

Color: Black; notum of thorax very slightly metallic and pleural region sometimes with a greenish or bronzy reflection; head often with blue-green reflections (in males the ocellocular area and upper part of front between eye and scrobal cavity sometimes somewhat bronzy or metallic); flagellum of antenna grayish dull dark brown, obscurely ferruginous at apex and sometimes extensively so beneath; scape greenish or with a green luster; legs brown to blackish brown; femora, especially the posterior pair, with a greenish luster (quite green or with a bronzy luster in the males); anterior tibiae pale brown to testaceous except a dark stripe above; tarsi testaceous; wings hyaline, veins brown to testaceous.

*Male*.—Length about 2.5–3 mm. Similar to female; part of scape bearing sensorial punctures fairly broad apically and occupying more than one-third but less than one-half of scape, sensoria fairly dense and moderately coarse.

*Type*.—U.S.N.M. no. 49780.

*Type locality*.—"Canada."

*Remarks.*—Described from four females and three males, all in the United States National Museum. The type and two female paratypes bear the number 2066, the allotype and one of the male paratypes the number 2068, and one male paratype the number 2021. These were collected by C. F. Baker in Canada. One female paratype is from Lakehurst, N. J.

**PERILAMPUS CAPITATUS, new species**

*Female.*—Length about 2–3 mm. Head: Frons without a carina, meeting vertex in a sharp angle (very rarely not very sharp); emargination of frontovertex markedly obtuse; ocellocular area and frons between eye and scrobal cavity smooth except for hair punctures; malar furrow more than half the width of cheek at apex (in males sometimes no more than half the width); clypeus wider than long and more or less longer than hyperclypeal area; cheeks convexly rounded and smooth; head in front view, with very rare exceptions, distinctly transverse; eyes about reaching level of base of clypeus.

Thorax: Area along inner margins of parapsides smooth; umbilicate punctures on mesoscutum and scutellum large and angulated, the interspaces usually thin, sometimes slightly thickened along median line of thorax; scutellum more or less distinctly broadened apically; pronotum laterally as long as or not much shorter than dorsal margin of prepectus, the carinate margins of prepectus not converging ventrally to form a single carina; axilla with a triangular or roughly triangular extension on side of scutellum, this extension as wide as or wider than long with its base extending above middle of axilla, the face of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum usually not turning caudad medially but meeting to form a single curved furrow, occasionally meeting in a slight angle; postmarginal vein about three-fourths or more than three-fourths the length of the marginal vein.

Abdomen: Posterior face broader than long to longer than broad (sometimes very distinctly longer than broad in the males); first tergite strongly transverse, smooth or weakly sculptured, its anterior margin more or less distinctly elevated and truncate or slightly convex, sometimes completely masking posterior aspect of neck of propodeum; third segment (second of the gaster) not at all or only slightly exposed.

Color: Black, the punctate portion of notum of thorax sometimes bronzy black; flagellum of antenna grayish black to grayish dull dark brown, usually paler at tip and beneath; scape rarely with a greenish luster; legs black; anterior tibiae brown to testaceous except a basal stripe above; middle and posterior tibiae reddish testaceous



at apex, sometimes wholly brown except a stripe above; tarsi testaceous or reddish testaceous; wings hyaline, veins testaceous to brown.

*Male*.—Length about 1.75–2.75 mm. Similar to female; portion of scape bearing sensorial punctures fairly broad apically and occupying somewhat more than one-third to about one-half of scape, sensoria fine to moderately coarse and dense.

*Type*.—U.S.N.M. no. 49776.

*Type locality*.—Fennville, Mich.

*Remarks*.—Described from 55 females and 46 males, all in the United States National Museum. Most of these were obtained "from bands on apple" in the codling moth survey of 1930 by the U. S. Bureau of Entomology. The type and allotype are labeled "Codling Moth Survey 1930, Coll. L. Brown, June, 1930." Six of the paratypes were taken at East Falls Church, Va., by L. H. Weld, June 30, 1926.

*Distribution*.—New York (Sept.); New Jersey (June); Pennsylvania; Delaware (Aug.); Maryland (July, Aug.); Virginia (June); Kentucky (June); Indiana (June, July, Aug.); Michigan (May, June, Aug., Sept.).

*Hosts*.—One specimen in the U. S. National Museum from Staunton, Va., is labeled "ex *Cremastus* cocoon, Oriental Fruit Moth Investigation, specimen no. 1295." Another, from Fennville, Mich., is labeled "bred from codling moth larva, June 1926 by L. G. Gentner." A third specimen is labeled "Reared from parasitized codling moth, Dover, Del., Aug. 13, 1920, E. R. Selkregg, Quaint. no. 14123." The last two specimens were probably hyperparasitic.

#### PERILAMPUS ANOMOCERUS Crawford

*Perilampus anomocerus* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 72, 1914.

*Female*.—Length about 1.75–2.5 mm. Head: Frons without a carina, meeting vertex in a curve; emargination of frontovertex not very deep or pronounced; cheeks straight or nearly straight; clypeus sometimes as long as broad and hyperclypeal area sometimes almost as long as clypeus; head in front view slightly transverse, rarely elongate, and usually subtriangular (in the males rarely distinctly transverse); eyes not reaching level of base of clypeus (may reach same in the males); third joint (ring joint) of antennae as long as wide, rarely shorter than wide, second joint (pedicel) usually very distinctly longer than wide; front and face, except hyperclypeal area, rather densely pubescent with stout whitish hair.

Thorax: Area along inner margin of parapsides smooth or finely aciculate; umbilicate punctures on mesoscutum and scutellum round or roundish; interspaces rather broad, especially so near middle of mesoscutum, finely lineolately sculptured except near the middle line of mesoscutum and scutellum, the scutellum laterally not granularly

opaque although sometimes rather closely lineolated; pronotum laterally as a rule shorter or no longer than the prepectus measured on a line bisecting angle of latter at tegula of wing; axilla with a triangular or roughly triangular extension about as wide as or somewhat wider than long on side of scutellum, its base extending to or above middle of axilla, surface of axilla sloping toward base of extension and not depressed above base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially but united at median line to form a single gently curved furrow; wing hairs short and dense.

Abdomen: Posterior face wider than long or as wide as long, rarely longer than wide, with some conspicuous hairs on each side of the middle; first tergite strongly transverse, usually coarsely sculptured but rarely smooth, its anterior margin strongly elevated and convex completely masking posterior aspect of neck of propodeum and very often resting on latter so as to give the appearance of a distinct petiole.

Color: Green or greenish, the propodeum sometimes black; notum of thorax including areas along inner margins of parapsides more or less coppery or bronzy; upper part of head often and rarely the whole head somewhat bronzy or coppery; abdomen black; flagellum of antenna grayish dark brown to ferruginous, the underside except apically usually paler than above; scape more or less concolorous with head; femora greenish or bronzy with apices narrowly testaceous; tibiae reddish testaceous to ferruginous; tarsi testaceous to reddish testaceous; wings hyaline, sometimes with a small darkish or brownish spot or patch at apex of submarginal vein; veins brown or reddish brown, paler basally.

*Male*.—Length about 1.75–2.25 mm. Similar to female; portion of scape bearing sensorial punctures not greatly broadened apically and occupying approximately one-half of scape, sensoria fine.

*Type*.—U.S.N.M. no. 18302.

Redescribed from 47 females and 19 males, including type, allotype, and paratypes, all in the United States National Museum. This appears to be a western species.

*Distribution*.—Colorado; Idaho (July).

#### PERILAMPUS GRANULOSUS Crawford

*Perilampus granulatus* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 73, 1914.

*Female*.—Length about 1.75–2.75 mm. Head: Frons without a carina, meeting vertex in a curve; emargination of frontovertex not very deep or pronounced; cheeks straight or nearly straight; head in front view slightly to rather distinctly transverse and usually subtriangular; lower extremity of eye above level of base of clypeus;

third joint (ring joint) of antennae wider than long, second joint (pedicel) usually a little longer than wide; front and face, except hyperclypeal area, rather densely pubescent with stout whitish hair.

**Thorax:** Area along inner margin of parapsides smooth, sometimes finely aciculate or reticulate; umbilicate punctures on mesoscutum and scutellum round or roundish, the interspaces on mesoscutum and middle of scutellum more or less conspicuously broad and usually in large part smooth, the scutellum laterally with dense granular sculpture; pronotum laterally usually distinctly longer than prepectus measured on a line bisecting the angle of latter at tegula of wing; axilla with a triangular or roughly triangular extension as wide as or wider than long on side of scutellum, its base extending to or above middle of axilla, surface of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially but meeting on the median line to form a single gently curved furrow, rarely forming a slight angle medially; wing hairs rather short.

**Abdomen:** Posterior face wider than long to longer than wide (the latter condition usually better marked in the males); area on each side of middle sparsely covered with long hairs; first tergite strongly transverse, usually smooth or weakly sculptured, the anterior margin strongly elevated and convex, completely masking posterior aspect of neck of propodeum, sometimes resting on latter and appearing to form a petiolelike tergite.

**Color:** Head green to cupreous, usually with more or less of front and face dark olive green or blackish; thorax green or greenish, the notum usually more or less cupreous (in males sometimes entirely so), propodeum and pleural regions in large part black; abdomen black, usually with more or less of a greenish or cupreous cast; flagellum of antenna grayish dull dark brown to ferruginous, more or less pale on underside except usually at apex; scape greenish brown to cupreous; femora green, bronzy, or brown with apices testaceous to ferruginous; tibiae reddish testaceous to ferruginous; tarsi testaceous or reddish testaceous; wings hyaline, very often with a small darkish or brownish spot or patch at apex of submarginal vein and sometimes with a faint cloud below marginal vein; veins brown to ferruginous, paler basally.

*Male*.—Length about 1.75–2.5 mm. Similar to female; portion of scape bearing sensorial punctures not greatly broadened apically and occupying somewhat over one-third to nearly one-half of scape, sensoria fine to moderately coarse.

*Type*.—U.S.N.M. no. 18305.

*Remarks*.—Redescribed from 11 females and 8 males, including type, allotype, and paratype, all in the United States National Museum except four in the collection of the Academy of Natural Sciences of Philadelphia.

This species has been reared from two lepidopterous insects, *Ancylis comptana* Froelich and (*Phthorimaea*) *Gnorimoschema operculella* Zeller, but very likely as a hyperparasite.

*Distribution*.—New Jersey (June); Delaware (June); Maryland (June); North Carolina (Nov.); Alabama; Louisiana (Sept.); Kansas; Texas (Aug., Sept.).

PERILAMPUS GAHANI, new species

*Female*.—Length about 2–3 mm. Head: Frons without a carina, completely or in part weakly and irregularly wrinkled or aciculate; face and cheeks similarly sculptured except that clypeus and hyperclypeal area are smooth; temples finely aciculate-striate; cheeks convexly rounded, sometimes only slightly so; head in front view transverse; eyes about reaching or falling somewhat short of level of base of clypeus; vertex behind ocelli more or less transversely rugose or striate.

Thorax: Area along inner margin of parapsides smooth or in part very finely reticulated; umbilicate punctures on mesoscutum and scutellum angulated, the interspaces thin; axilla with a triangular or roughly triangular extension as wide as or wider than long on side of scutellum, and extending more or less above middle of axilla, the face of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially and meeting at an angle; wing hairs short.

Abdomen: Posterior face ranging from somewhat wider than long to longer than wide; first tergite petioliform, without an elevated anterior margin or flange and usually more or less rugosely sculptured.

Color: Black or blackish; face and area along inner margins of parapsides distinctly greenish; head and thorax usually in part cupreous or with a cupreous tinge, the thorax sometimes mostly so; abdomen sometimes in part greenish with its apex often tinged with cupreous; flagellum of antenna grayish brown to ferruginous, more or less pale on underside; scape concolorous with head; coxae and femora greenish, the apices of latter testaceous or reddish testaceous; tibiae reddish testaceous to ferruginous, the posterior pair sometimes with a greenish tinge above; tarsi testaceous or reddish testaceous; wings hyaline.

*Type*.—U.S.N.M. no. 49779.

*Type locality*.—Bernalillo County, N. Mex.

*Remarks*.—Described from four females, all in the United States National Museum. The type was collected by B. Brown, June 1896, and bears the number 259; two of the paratypes are from Albuquerque, N. Mex., and the third from Colorado, from the C. F. Baker Collection, no. 1227.

**PERILAMPUS FULVICORNIS** Ashmead

*Perilampus fulvicornis* ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, p. 126, 1886.

*Female*.—Length about 1.5–3.5 mm. Head: Frons without a carina, meeting vertex in more or less of a curve although sometimes with a semblance of a carina behind the anterior ocellus; front and face completely or almost completely smooth except for hair punctures; cheeks convexly rounded, rarely nearly straight; head in front view transverse but sometimes only slightly so and very rarely subtriangular; eyes about reaching level of base of clypeus (in males sometimes reaching beyond).

Thorax: More or less compact; area along inner margins of parapsides smooth or only finely sculptured; umbilicate punctures on mesoscutum and scutellum angulated, rarely nearly round, the interspaces thin and usually with distinct, fine, reticulate sculpture; anterior edge of pronotum at lateral angles sharp, not depressed, the punctate portion of pronotoprepectal area at dorsal margin occupying half or more than half the distance between anterior edge of pronotum and the tegula of wing; axilla with a triangular or roughly triangular extension about as wide as or wider than long on side of scutellum, its base extending to about middle or above middle of axilla, the face of axilla sloping toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially and meeting on the median line in an acute or subacute angle; neck of propodeum usually coarsely sculptured; wing hairs usually short.

Abdomen: Posterior face usually wider than long or about as long as wide, rarely considerably longer than wide (the longer-than-wide type of abdomen more common among the males); first tergite petioliform, without an elevated anterior margin or flange and more or less rugosely sculptured, rarely almost entirely smooth.

Color: Black; head sometimes grayish, clypeus rarely bronzy or cupreous; punctate portion of notum of thorax sometimes bronzy and area along inner margin of parapsides very rarely with a greenish reflection; abdomen often with a greenish reflection beneath; flagellum of antenna grayish dull dark brown to ferruginous and more or less pale beneath, sometimes entirely ferruginous; scape blackish, sometimes with a greenish or cupreous tinge; femora brown to black, often tinged with metallic, their apices usually testaceous or reddish testaceous; tibiae brown to ferruginous, with more or less of apices testaceous or reddish testaceous, the anterior pair sometimes entirely testaceous and sometimes all of tibiae so, the posterior pair rarely blackish and often more or less greenish; tarsi testaceous or reddish testaceous; wings hyaline, veins pale testaceous to dark testaceous.

*Male*.—Length about 1.5–3 mm. Similar to female; portion of scape bearing sensorial punctures slightly broadened to quite broad

apically and occupying about one-third to somewhat more than one-half of scape, sensoria usually coarse or moderately coarse.

*Type*.—U.S.N.M. no. 22886.

Redescribed from a large series of specimens of both sexes including the type, which is a male from eastern Florida.

*Distribution*.—Widely distributed and apparently a rather common species. I have seen material from the District of Columbia and two or three provinces in Canada, including British Columbia (June), and from the following States: Maine (June, July); New Hampshire (July, Aug., Sept.); Massachusetts (July, Aug.); Rhode Island (Aug.); New York (July, Aug.); New Jersey (July to Oct., incl.); Pennsylvania (July, Aug., Sept.); Delaware (June, Aug.); Maryland (June to Sept., incl.); Virginia (July, Aug., Sept. "captured on thistle"); Florida (July); West Virginia; Ohio (April to Sept., incl.); Michigan; Indiana (Aug., Sept.); Illinois (April, July, Aug.); Missouri (July); Arkansas (July); Louisiana; Kansas (Aug.); Oklahoma; Texas (May to Dec., incl.); Colorado (Aug.); Nevada (July); Washington (May); California.

*Hosts*.—*Zenillia* (*Exorista*) sp., *Ascogaster* sp., *Cremastus cooki* Weed, *Meteorus* sp., *Apanteles* sp., *Macrocentrus pallisteri* De Gant, "hymenopterous cocoons."

The species has been reared in association with a number of lepidopterous insects, but very likely it was hyperparasitic.

**PERILAMPUS FULVICORNIS PROTHORACICUS, new variety**

*Female*.—Length about 2–3 mm. Differs from *fulvicornis* Ashmead in three essential respects: (1) Anterior edge of pronotum at lateral angles depressed, the punctate portion of pronotoprepectal area at dorsal margin short, seemingly occupying distinctly less than half the distance between anterior edge of pronotum and the tegula of wing; (2) basal shallow furrows on underside of apex of scutellum not turning caudad medially or turning caudad only slightly and meeting on the median line to form a single more or less curved furrow or an obtuse angle; (3) neck of propodeum weakly sculptured, only rarely coarsely sculptured.

Other differences are as follows: Area along inner margins of parapsides usually rather distinctly sculptured or roughened; interspaces between unbilicate punctures on scutellum apparently always entirely finely reticulated; base of extension of axilla on side of scutellum sometimes not quite reaching to middle of axilla; wing hairs, post-marginal vein, and stigmal vein usually long; head often with a greenish tinge and sometimes distinctly greenish; thorax often a gray metallic black, the areas along inner margins of parapsides rarely bronzy; abdomen often with a distinct gray reflection; wings rarely with a very faint brownish cloud beneath marginal vein.

*Type*.—U.S.N.M. no. 49785.

*Type locality*.—Louisiana.

*Remarks*.—Described from 15 females, of which the type and 10 paratypes are in the United States National Museum. The type is labeled "Loui. 5668, collection C. F. Baker." One paratype in the same museum bears Quaintance no. 11779 (Aug.); one is from Oakland, Md. (July); one from Marquette, Mich. (July); one from St. Louis, Mo. (July); three from Nebraska; two from the "Codling Moth Survey 1930" (May), Yakima, Wash., L. Brown, collector, and one from the same locality, "reared from codling moth" (Sept.), E. J. Newcomer, collector. Of the remaining four, one from Falls Church, Va. (Sept.), is in the Museum of Comparative Zoology, and three from Mount Washington, N. H., from the collection of Mrs. A. T. Slosson, no. 26226, in the American Museum of Natural History.

The specimen said to have been reared from the codling moth was probably hyperparasitic.

The status of this variety may possibly have to be changed with the receipt of additional material for study.

#### PERILAMPUS STYGICUS Provancher

*Perilampus stygicus* PROVANCHER, Additions et corrections au volume II de la . Faune entomologique du Canada traitant des Hyménoptères, p. 406, 1888.

*Female*.—Length about 1.75–2.25 mm. Head: Frons meeting vertex in more or less of a curve, without a carina, except sometimes with a faint one extending for a short distance on the upper part; front and face practically smooth; hyperclypeal area often as long as clypeus; cheeks straight or nearly straight; head in front view somewhat transverse and sometimes subtriangular; eyes not quite reaching level of base of clypeus.

Thorax: Area along inner margin of parapsides smooth or but finely sculptured; umbilicate punctures on mesoscutum and scutellum more or less angulated, interspaces thin although rarely slightly thickened on scutellum medially; whole scutellum and mesoscutum in part with the interspaces finely reticulately sculptured; anterior edge of pronotoprepectal area usually depressed, the punctate portion actually or seemingly occupying distinctly less than half the area between anterior edge of pronotum and tegula of wing, usually appearing as a narrow anterior border; axilla with a triangular or roughly triangular extension as wide as or wider than long on side of scutellum extending to or above middle of axilla, face of axilla sloping more or less toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum not turning caudad medially or turning only slightly and meeting on the median line to form a single more or less curved furrow or an obtuse angle; neck of propodeum finely sculp-

tured, somewhat more coarsely so laterally; wing hairs usually long and rather dense.

Abdomen: Posterior face wider than long or about as wide as long (in males sometimes somewhat longer than wide); first tergite petioliform, without an elevated anterior margin or flange and more or less rugosely sculptured.

Color: Black; head grayish black or greenish black, the vertex, hyperclypeal area and clypeus sometimes bronzy or brassy; notum of thorax somewhat grayish black, the area along inner margin of parapsides sometimes metallic black (latter sometimes bronzy in the males); abdomen sometimes in part brown or brownish black (usually with a gray reflection in males); flagellum of antenna grayish dull dark brown to ferruginous, more or less pale beneath; scape brown to blackish, sometimes with a greenish tinge; legs brown to ferruginous; coxae and femora blackish with more or less of a greenish tinge and sometimes quite green, the apices of femora usually testaceous or reddish; apices of posterior and intermediate tibiae testaceous or reddish, the anterior pair and sometimes also the intermediate wholly testaceous or reddish except for a more or less distinct darker stripe above; tarsi testaceous or reddish; wings with an infuscated spot or cloud below marginal vein.

*Male*.—Length about 1.75–2 mm. Similar to female; frons sometimes meeting vertex at somewhat of an angle; front and face sometimes in large part aciculate; cheeks sometimes more or less convexly rounded; head in front view sometimes rather distinctly transverse; eyes sometimes reaching below level of base of clypeus; portion of scape bearing sensorial punctures broadened throughout its whole length and comprising nearly whole length of scape, usually somewhat stouter basally, the inner margin faintly concave in its apical half; sensoria fine to fairly coarse and dense, absent at apex.

*Type*.—In the Museum of Public Instruction, Quebec, Canada. I have not seen it.

*Remarks*.—Redescribed from eight females and seven males believed to be this species. Eight specimens are in the United States National Museum, six in the collection of the Boston Society of Natural History, and one in the collection of Prof. C. T. Brues, of Harvard University. It is quite likely that my definition of the species, based upon the above 15 specimens, is in some respects too narrow.

*Distribution*.—I have seen material from "Canada"; Maine (July, Aug.); Massachusetts (Aug.); New York (Aug.); New Jersey (Aug.); Maryland; District of Columbia; Virginia; Ohio; Louisiana; Kansas. Provancher described the species from Cap Rouge, Quebec.

*Host*.—*Macrocentrus* sp. The species is said to have been reared also from the lepidopteron *Epiblema strenuana* Walker "in *Ambrosia*", but was probably a hyperparasite.



## PERILAMPUS SIMILIS Crawford

*Perilampus similis* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 73, 1914.

*Female*.—Length about 1.75–3.75 mm. Head: Frons without a carina, although rarely (more particularly in the males) with a semblance of a carina on the upper part; the union of vertex and front usually forming a sharp angle in the ocellar region; front and face smooth, except for hair punctures, rarely aciculate or slightly wrinkled along lateral margins of clypeus; cheeks straight or nearly straight; head in front view transverse, sometimes only slightly so, usually subtriangular in outline (less often so in the males); eyes as a rule not reaching level of base of clypeus (usually reaching same in males).

Thorax: Area along inner margins of parapsides smooth; interspaces between umbilicate punctures on mesoscutum and scutellum medially usually slightly thickened or widened (less commonly so in the males), the punctures with the more conspicuously thickened walls round or roundish; anterior edge of pronotum at lateral angles not depressed, the punctate portion of pronotoprepectal area at dorsal margin occupying half or more than half of distance from anterior edge of pronotum to tegula of wing; axilla with a triangular or roughly triangular extension as wide as or wider than long on side of scutellum, the base extending to or above middle of axilla, face of axilla sloping more or less toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially and meeting or nearly meeting on the median line to form an acute angle, rarely an obtuse angle; propodeal neck, except very rarely, coarsely sculptured; wing hairs usually pale and wings clear; apex of postmarginal vein usually distinct.

Abdomen: Posterior face usually longer than wide, often considerably so (latter condition more common among the males); first tergite petioliform, without an elevated anterior margin or flange and more or less rugosely sculptured, sometimes in large part smooth.

Color: Head black or black with a metallic tinge, rarely in part bronzy; thorax black, the punctate portion of notum usually bronzy black, rarely greenish black, the areas along inner margins of parapsides usually with a greenish or bronzy tinge, otherwise metallic black; pleural region usually with a very slight greenish or bronzy tinge or reflection; abdomen shining black, sometimes with a greenish tinge; flagellum of antenna grayish dull dark brown to ferruginous and usually more or less pale beneath; scape black or greenish; femora brown to black, sometimes with a greenish cast or reflection which is usually more pronounced on the posterior pair, their apices sometimes testaceous or reddish; tibiae brown to ferruginous, sometimes with a slight metallic cast, the anterior pair usually reddish testaceous except

a stripe above, the middle and posterior pairs sometimes darker above, at least basally; tarsi testaceous or reddish; wings hyaline, veins testaceous to dark brown.

*Male*.—Length about 1.75–2.75 mm. Similar to female; portion of scape bearing sensorial punctures slightly broadened to quite broad apically and occupying slightly more than one-third to about one-half of scape, sensoria fine to moderately coarse.

*Type*.—U.S.N.M. no. 18303.

Redescribed from 71 females and 38 males, including the type and 3 female paratypes. Nearly all the above material is in the United States National Museum. This is evidently a western species.

*Distribution*.—North Dakota (July, Aug. "taken from sunflowers"); Nebraska (June); Kansas (July); Texas (Feb. to Oct., inclusive and ?Dec.; taken in April "on *Lepidium*", in June "from *Sphaeralcea angustifolia*", and in September "on *Amorpha fruticosa*"); Colorado (May, Aug.); New Mexico (April "on *Sisymbrium*", June, Sept. "on *Bigelovia*"); Idaho (June, July); Arizona; Oregon (June, Aug.); California.

The species has been reared in association with *Acrobasis* sp., but very likely as a hyperparasite. One specimen is labeled "on *Eulophus*, Dallas, Texas, 9-V-'06, F. C. Bishopp coll."

PERILAMPUS MUESEBECKI, new species

*Female*.—Length about 1.5–2.75 mm. Head: Frons without a carina, meeting vertex in more or less of a curve; emargination of frontovertex apparently never very pronounced; front and face smooth except for hair punctures; hyperclypeal area usually as long as or about as long as clypeus; cheeks straight or nearly straight; head in front view more or less elongate or slightly transverse and as a rule subtriangular; eyes not reaching level of base of clypeus.

Thorax: Area along inner margin of parapsides smooth or practically smooth; umbilicate punctures on mesoscutum and scutellum angulated and interspaces thin, mere septa; anterior edge of pronotum at lateral angles not depressed, the punctate portion of pronotoprepectal area dorsally long, occupying half or more than half of distance between anterior edge of pronotum and the tegula of wing; axilla with a triangular or roughly triangular extension about as wide as or wider than long on side of scutellum, the base extending about to middle or above middle of axilla, face of axilla sloping more or less toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially and meeting or nearly meeting on the median line to form an acute or subacute angle; neck of propodeum coarsely sculptured, very rarely with weak sculpture; wing hairs short and usually dark but sometimes in large part pale; postmarginal vein

longer than stigmal vein and usually merging with the darkish costal border of the wing, the apex rather indistinct; thorax very distinctly less than 1.5 mm long.

Abdomen: Posterior face ranging from somewhat wider than long to longer than wide; first tergite petioliform, without an elevated anterior margin or flange and more or less rugosely sculptured, sometimes in large part smooth.

Color: Black; head grayish black, rarely with a greenish reflection, and sometimes brown, area along inner margins of parapsides very rarely greenish, abdomen sometimes with a greenish reflection beneath; flagellum of antenna grayish brown to ferruginous and more or less pale beneath; scape greenish, rarely brown; coxae and femora brown to blackish, the femora, especially the posterior pair, with a greenish tinge and sometimes quite green, their apices sometimes testaceous or reddish; tibiae brown to ferruginous, the anterior pair usually testaceous or reddish except for a stripe above, the posterior and intermediate pairs usually darker with their bases and apices reddish testaceous; tarsi testaceous or reddish; wings hyaline, veins testaceous, usually reddish basally.

*Male*.—Length about 1.5–2 mm. Similar to female; portion of scape bearing sensorial punctures somewhat broadened apically and occupying between one-third and one-half of scape, sensoria fine to moderately coarse and dense. Anterior and intermediate tibiae sometimes entirely testaceous except for a stripe on latter above. In some males the eyes reach the level of base of clypeus. In one male specimen, believed to be this species, the cheeks are somewhat convexly rounded and the head appears rather distinctly transverse.

*Type*.—U.S.N.M. no. 49783.

*Type locality*.—Washington, D. C.

*Remarks*.—Described from a series of 24 females and 14 males of which the type, allotype, and 33 paratypes are in the United States National Museum. The type is labeled "Washington, D. C."; the allotype, "D. C., Aug. 24, '84." Of the paratypes in the National Museum two females are from Nelson, N. H. (Aug.); one female from Lake George, N. Y. (Aug., J. L. Zabriskie); five females and nine males from Virginia, two of these males from Blacksburg (Sept. and Oct.), the others without definite locality; one male from eastern Florida (Ashmead); five females and one male from "West Pt.", Nebr. (Sept., J. C. Crawford, collector); seven females from Riley County, Kans. (Sept., Marlatt); one female from Colorado, from the C. F. Baker Collection; and one male from Fitch's Collection, bearing the number 14978. Of the remaining three paratypes, one female and one male, from Big Island and Mosholu, N. Y. (Sept.), respectively, are in the American Museum of Natural History; and one female from Mount Airy, Pa. (Sept.), bearing the number 126, is in the collection of the Academy of Natural Sciences of Philadelphia.

## PERILAMPUS ROBERTSONI Crawford

*Perilampus robertsoni* CRAWFORD, Proc. Ent. Soc. Washington, vol. 16, p. 71, 1914.

*Female*.—Length about 2.5–3 mm. Head: Frons meeting vertex in a more or less sharp angle, sometimes with a semblance of a carina; emargination of frontovertex usually conspicuous, the scrobal cavity rather deep, its sides sloping rather sharply; front and face smooth except for hair punctures; hyperclypeal area as long as or nearly as long as clypeus; cheeks straight or nearly straight; head in front view somewhat elongate and subtriangular, very distinctly narrowed below eyes; eyes not reaching level of base of clypeus; face below eyes sometimes somewhat concave.

Thorax: Area along inner margin of parapsides smooth (sometimes more or less roughened in the males); umbilicate punctures on mesoscutum and scutellum angulated, interspaces thin, mere septa; anterior edge of pronotum at lateral angles not depressed, the punctate portion of pronotoprepectal area dorsally occupying half or more than half of distance between anterior edge of pronotum and tegula of wing; axilla with a triangular or roughly triangular extension as wide as long on side of scutellum, the base extending to or above middle of axilla, face of axilla sloping more or less toward base of extension and not depressed or excavated above base of extension; basal shallow furrows on underside of apex of scutellum turning caudad medially and meeting on the median line at an acute angle; neck of propodeum coarsely sculptured; wing hairs short and pale; postmarginal vein about as long as or only slightly longer than stigmal vein, its apex rather distinct; thorax as a rule about 1.5 mm in length.

Abdomen: Posterior face more or less longer than wide; first tergite petioliform, without an elevated anterior margin or flange and usually more or less rugosely sculptured, sometimes almost entirely smooth.

Color: Black; head and abdomen often with a grayish reflection; flagellum of antenna grayish dull dark brown to grayish brown, more or less pale on under side; scape greenish; legs brown, in part with a greenish tinge or reflection, coxae and femora sometimes black or blackish, the apices of femora sometimes testaceous or reddish, tips of intermediate and posterior tibiae and anterior tibiae except a stripe above testaceous or reddish, tarsi testaceous or reddish; wings hyaline, veins testaceous, sometimes reddish basally.

*Male*.—Length about 2.25–2.75 mm. Similar to female; but the frons meeting vertex in a distinct angle, often with a rather distinct carina above, the emargination of frontovertex more pronounced and the sides of scrobal cavity more sharply sloping than in the female; head usually somewhat transverse and eyes usually reaching base of clypeus; scape rather broad apically, the portion bearing sensorial

punctures occupying more than one-third but less than one-half of scape, sensoria rather fine to moderately coarse and dense; anterior and intermediate tibiae sometimes entirely testaceous except for a darker stripe on latter above.

*Type*.—U.S.N.M. no. 18299.

Redescribed from three females and six males, including type, allotype, and male paratype. The material is in the United States National Museum.

*Distribution*.—"Canada"; Illinois; Nebraska (Sept.); Colorado.

#### UNIDENTIFIED SPECIES

##### PERILAMPUS ALEXINUS Walker

*Perilampus alexinus* WALKER, List of the specimens of hymenopterous insects in the collection of the British Museum, Chalcidites, pt. 1, p. 89, 1846.

*Type*.—Presumably in the British Museum.

This appears in the British Museum list as an American species, although no locality is given. Dalla Torre, in his catalog of the Hymenoptera, lists it as a synonym of *hyalinus* Say, but it does not seem to be this species, judged from the description. In fact, it does not appear to belong to the *hyalinus* group of species.

##### PERILAMPUS CYANEUS Brullé

*Perilampus cyaneus* BRULLÉ, Histoire naturelle des insectes, Hyménoptères, vol. 4, p. 573, 1846.

*Type*.—Presumably in the Muséum d'Histoire Naturelle in Paris. "Hab. la Caroline." From the former Bosc Collection.

It is possible that I have redescribed this species as new under the name of *carolinensis*, since Brullé in his description states that the "vertex" is very strongly punctured; on the other hand, it may well be *hyalinus* Say or possibly even *chrysopae* Crawford, although the color characters would seem to preclude *chrysopae*.

##### PERILAMPUS ENTELLUS Walker

*Perilampus entellus* WALKER, Ann. Mag. Nat. Hist., ser. 1, vol. 12, p. 103, 1843.

*Type*.—Presumably in the British Museum.

"Found by R. Forster, Esq., in Ohio."

Dalla Torre calls this species a synonym of *platygaster* Say, but it is clearly not that species, judged from the description. It may be Say's *hyalinus* or my *carolinensis*.

## PERILAMPUS LAEVIS Provancher

*Perilampus laevis* PROVANCHER, Additions et corrections au volume II de la Faune entomologique du Canada traitant des Hyménoptères, p. 199, 1887.

*Type*.—In the W. Hague Harrington Collection, Ottawa, Canada. "Ottawa (Harrington)."

This species may not be a *Perilampus* at all, as suggested by Provancher himself in connection with the description.

## PERILAMPUS LEPREOS Walker

*Perilampus lepreos* WALKER, List of the specimens of hymenopterous insects in the collection of the British Museum, Chalcidites, pt. 1, p. 89, 1846.

*Type*.—Presumably in the British Museum.

"a. Georgia. From Mr. Abbot's collection."

Dalla Torre lists this species as a synonym of *P. triangularis* Say, probably, as in the case of *alerinus* and *entellus*, on the authority of the elder Cresson.<sup>14</sup> It is difficult to say from the description whether it is *triangularis*, but if it is it belongs in *Euperilampus*, in which genus *P. triangularis* Say is now placed.

## KNOWN HOST LIST

Host	Species of <i>Perilampus</i>
DIPTERA	
<i>Achaetoneura euchaetiae</i> Webber.....	<i>hyalinus</i> Say.
<i>melalophae</i> Allen.....	<i>hyalinus</i> Say.
<i>Compsilura concinnata</i> Meigen.....	<i>hyalinus</i> Say.
<i>Ernestia ampelus</i> Walker.....	<i>hyalinus</i> Say.
? <i>Ernestia ruficauda</i> (Brauer).....	<i>hyalinus</i> Say.
<i>Zenillia</i> ( <i>Exorista</i> ) sp.....	{ <i>canadensis</i> Crawford. <i>fulvicornis</i> Ashmead.
HYMENOPTERA	
<i>Apanteles</i> sp.....	<i>fulvicornis</i> Ashmead.
<i>hyphantriae</i> Riley.....	<i>hyalinus</i> Say.
<i>melanoscelus</i> Ratzeburg.....	<i>hyalinus</i> Say.
<i>Ascogaster</i> sp.....	<i>fulvicornis</i> Ashmead.
<i>Cremastus</i> sp.....	<i>capitatus</i> Smulyan.
<i>cooki</i> Weed.....	<i>fulvicornis</i> Ashmead.
<i>Eulimneria</i> sp.....	<i>hyalinus</i> Say.
<i>valida</i> Cresson.....	<i>hyalinus</i> Say.
<i>Macrocentrus</i> sp.....	<i>stygius</i> Provancher.
<i>pallisteri</i> DeGant.....	<i>fulvicornis</i> Ashmead.
<i>Meteorus</i> sp.....	<i>fulvicornis</i> Ashmead.
<i>hyphantriae</i> Riley.....	<i>hyalinus</i> Say.
NEUROPTERA	
<i>Chrysopa</i> spp.....	<i>chrysopae</i> Crawford.
<i>californica</i> Coquillett.....	<i>chrysopae</i> Crawford.
<i>Symphorobius angustus</i> (Banks).....	<i>chrysopae</i> Crawford.

<sup>14</sup> Cresson, E. T., Synopsis of the families and genera of the Hymenoptera of America, north of Mexico, together with a catalogue of the described species, and bibliography, p. 235, 1887.

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## PYCNOGONIDS FROM PUGET SOUND

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PYCNOGONIDS are not commonly dredged in Puget Sound, Wash., but they are sometimes found in large numbers in certain rather isolated localities.<sup>1</sup> In the waters around the San Juan Islands, which have been quite thoroughly investigated, probably only half a dozen specimens have been collected in the past 10 years. On the other hand, with the investigation of the waters south of the San Juans, especially in the vicinity of McNeils Island, pycnogonids have been collected in large numbers among the hydroids dredged from rocky bottoms.

This paper is a report upon five species of pycnogonids, three of which are new, collected in Puget Sound and neighboring waters on dredging expeditions of the University of Washington's research ship *Catalyst*. Thanks are due Prof. T. G. Thompson, director of the university's oceanographic laboratories, and to Profs. T. Kincaid, J. E. Guberlet, Robert C. Miller, and M. H. Hatch, of the university's zoology department, for assistance and cooperation given.

### KEY TO PUGET SOUND SPECIES OF PYCNOGONIDS<sup>2</sup>

*a*<sup>1</sup>. Cheliferi with well-developed chelae, which lie in front of mouth.

*b*<sup>1</sup>. Palpi present; first segment bearing neck, from terminal part of which the palpi and cheliferi originate but which does not bear eye tubercle.....NYMPHONIDAE Hoek

<sup>1</sup> Compare with Hodgson's (1907) introduction.

<sup>2</sup> Compiled in part from Bouvier (1913); Cole (1904); Hall (1913); and Schimkewitsch (1913).



Ten-segmented oviger in both male and female, provided with a terminal claw, and last four segments armed with an inner row of elongate teeth; body elongated and distinctly segmented; 4 pairs of walking legs.....*Nymphon* Fabricius

♂. Chelae short and thick; eye tubercle pointed and turret-shaped; legs fairly well armed with slender spines (fig. 33, *g-k*).....*Nymphon turritum*, new species

♂. Chelae long and slender; eye tubercle heavy at base and with slender tip; legs almost naked (fig. 33, *a-d*)

*Nymphon solitarium*, new species

♂. Palpi absent; oviger present only in male and without terminal claw; body elongated, segmented; eye tubercle borne on anteriormost part of anterior segment; 4 pairs of legs; genital apertures in both male and female on all 4 legs

PHOXICHELIDIDAE Sars

Ovigera 5-segmented; first trunk segment not greatly produced in front above proboscis

(*Phoxichilidium* Edwards) *P. femoratum* (Rathke)

♂. Cheliferi weakly developed, shorter than proboscis, not chelate in adult forms; palpi usually longer than proboscis; ovigera present in both sexes, 10-segmented and without terminal claw; 4 pairs of legs; genital openings in male on legs 3 and 4, in female on all 4 pairs.....AMMOTHEIDAE Dohrn

♂. Cheliferi 2-segmented, palpi 8-segmented.....*Ammothea* Leach

♂. Cheliferi half as long as proboscis; abdomen reaching only to second coxal segment of posterior legs or slightly beyond (fig. 33, *e, f*).....*Ammothea discoidea*, new species

♂. Cheliferi less than half as long as proboscis; protuberance on dorsal side of first coxal segment half as long as segment, genital protuberance same length.....*Ammothea alaskensis* Cole

♂. Cheliferi 3-segmented, palpi 9-segmented

(*Ammotheella* Verrill) *A. longicaudata* (Stimpson)

### Genus NYMPHON Fabricius

#### NYMPHON SOLITARUM, new species

#### FIGURE 33, *a-d*

*Description*.—Body slender, elongated, segmentation conspicuous, lateral processes widely separated, legs very long and slender. Trunk segments almost equal in thickness, except posterior segment, which is slenderer; segments of approximately same length, each thickest where lateral processes originate, a little behind middle of segment. Anterior segment bearing high eye tubercle dorsal to origins of ovigera, which are anterior to walking legs; eye tubercle heavy and abruptly pointed distally, with eyes large and basal, sometimes almost contiguous (in some specimens eyes hardly visible and may be rudimentary). Anterior segment in front of eye tubercle prolonged into neck, which is swollen anteriorly, bearing the cheliferi dorsally, palpi laterally, and proboscis anteroventrally. Proboscis

cylindrical, slightly longer and much thicker than neck. Palpi with scape longer than second segment, slightly curved, almost as long as proboscis; second segment shorter and heavier than scape; both movable and immovable fingers long and slender and well-toothed on their inner margins. Immovable finger almost straight to distal part, which terminates in a curved tip; movable finger curved and longer than immovable; both fingers armed on their inner margin with teeth, some of which are almost contiguous at their bases, and all are pointed almost evenly to their apexes and somewhat curved.

Oviger a 10-segmented; first segment very short; second and third about equal and a little longer than the first; fourth about twice as long as first three together; fifth slenderer and longer than fourth, swollen at its distal end (it is this segment around which the eggs are carried in one or two closely packed masses); sixth segment much shorter and armed with many short hairs on its ventral side; seventh shorter than sixth and closely beset on its ventral margin with an even row of about 13 elongated spines, which are armed laterally, these spines almost touching one another at their bases and about as long as the segment is thick; eighth a little shorter than seventh and armed as seventh; ninth and tenth about equal to seventh in length and similarly armed; these last three segments are definitely curved on their ventral margins and form a curved end to the oviger as a whole; the tenth segment bears a long well-developed claw, which is armed with ordinary teeth on its ventral margin, as are the fingers of the chelae.

Legs almost naked, about 37 mm long; first coxa 0.6 mm, second 3 mm, third 1.2 mm, femur 7.2 mm and somewhat ventrally curved; first tibia 8.8 mm, second tibia 11.4 mm; first tarsus 2.6 mm, second tarsus 1.3 mm; claw 1 mm, unarmed on its ventral margin; auxiliary claw present but only one-fourth as long as true claw.

Abdomen finger-shaped, very short, and articulated to body segment.

*Measurements.*—Body 6–7 mm. A specimen 6 mm long measures: Proboscis 2 mm; neck 1.7 mm; first segment 1 mm; second segment 0.8 mm; third segment 0.8 mm; fourth segment 0.7 mm; abdomen 0.6 mm; second lateral process 0.7 mm long; eye tubercle 0.5 mm high.

*Types.*—Holotype: Male from Puget Sound collected May 7, 1933, U.S.N.M. no. 71496. Paratypes: 1 male carrying eggs collected half a mile southwest of Flat Point, San Juan County, from 30 meters, July 6, 1935; 1 specimen from Foulweather Bluff, February 25, 1934, from 50 to 80 meters; 1 specimen from Puget Sound (Professor Kincaid's collection); 1 specimen from Dougall Point (Pickering Pass), Puget Sound, May 6, 1933, from 16 fathoms.

*Remarks.*—*Nymphon solitarium* is placed with those species of *Nymphon* that have auxiliary claws and in which the first tarsus is considerably longer than the second. Among the species noted by Bouvier (1913) and Hodgson (1907), *N. solitarium* most closely resembles *N. meridionale* and *N. hiemale*. It is separated from these by the fact that the scape of the chelicera is shorter than the proboscis. See Bouvier (1913, p. 73) on Arctic and sub-Arctic species of *Nymphon*.

NYMPHON TURRITUM, new species

FIGURE 33, g-k

*Description.*—Body not so elongated as usual among members of the genus; lateral processes as long as or longer than segment of the body is wide, well separated. Proboscis long, cylindrical, without markings or ridges, somewhat ventrally inclined. Cheliferi well developed, the first segment or scape as long as proboscis and slightly bowed outward; hand or second segment shorter and heavier than first segment and inclined toward mouth, both preceding segments quite well clothed with hair and occasional spines; fingers very short and stout for member of this genus; immovable finger a little shorter than movable finger, both densely armed with long teeth along inner margin. Palpi with origin lateral to cheliferi, first segment very short, second and third long and slender, third a little longer than second and terminating in a well-developed ventrally curving spine and a circlet of hairs; segments 4 and 5 shorter, well clothed with hairs.

First segment with neck short and thick, greatly expanded at distal end for attachment of cheliferi and palpi, this part being heavier than any other portion of body. Eye tubercle directly dorsal to anterior part of first segment, which bears ovigera, very slender, tall, turret-shaped, very pointed at apex; eyes small, basal. In female paratype, eyes large and elongated, and eye tubercle slenderer than in holotype.

Ovigera attached directly in front of anterior pair of walking legs. First segment very short, second and third a little longer and heavier and almost equal in size; fourth and fifth very long and nearly equal in length; sixth much shorter but longer than second and third; seventh to tenth forming a curve and slenderer than preceding segments; seventh shorter than sixth and armed ventrally with a row of about 16 toothed spines; eighth a little shorter than seventh, armed with about 12 spines; ninth about equal in length to eighth, armed ventrally with about 9 spines; tenth almost equal to eighth and ninth, armed with about 12 ventral spines; claw very nearly as long as segment 10, slender, armed ventrally with spinelike teeth.

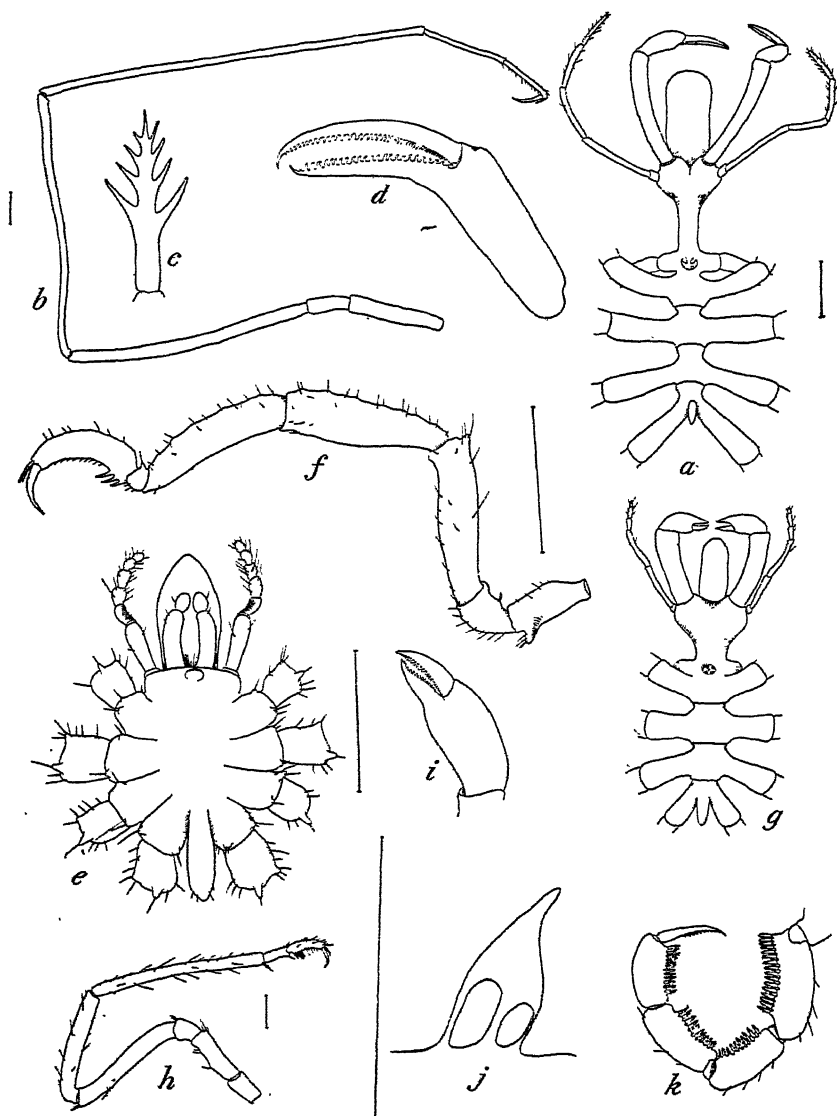


FIGURE 33.—NEW SPECIES OF NYMPHON AND AMMOTHEA

a-d, *Nymphon solitarium*: a, Body; b, leg; c, spine from oviger; d, chela of chelifer.

e, f, *Ammothea discoidea*: e, Body; f, leg.

g-k, *Nymphon turritum*: g, Body; h, leg; i, chela; j, eye tubercle; k, tip of oviger.

Lines drawn beside figures each represent 1 mm.

Legs very long but not so long or slender as in *N. solitarium*; first and third coxae about twice as long as wide and equal to one another in length; second coxa almost as long as other two combined, the three coxal segments together measuring 3 mm; femur 3.8 mm; first tibia 3.6 mm, second tibia 5.4 mm; first tarsus 0.8 mm, second tarsus 0.9 mm; claw 0.6 mm; auxiliary claws half as long as main claw. Legs armed sparingly with rather long slender spines. Second tarsus or foot armed underneath with a single row of approximately seven spines, the first four of which are long and well developed.

Abdominal segment inclined posterodorsally, long and fingerlike, considerably longer than the eye tubercle is high.

*Measurements*.—Body 5 mm; proboscis 1.2 mm; first segment 1.6 mm; neck 0.9 mm; trunk 3.2 mm; abdominal segment 0.6 mm; eye tubercle 0.4 mm; lateral process 0.6 mm long.

*Types*.—Holotype: A specimen collected near Caldron Rock, Puget Sound, dredged from 70 meters, July 10, 1935, U.S.N.M. no. 71498. Paratypes: 2 specimens, 1 female and 1 probably immature, dredged from rocky bottom in 50 meters off O'Neal Island.

*Remarks*.—*Nymphon turritum* belongs to the group of *Nymphon* that possesses auxiliary claws and in which the first tarsus is shorter than the second. This group includes *N. gracile*, *N. tridentatum*, and *N. adareanum*. *N. turritum* most closely keys out to *gracile* (Bouvier, 1913, p. 73) except that the third segment of the palpus is a little longer than any other of the palpal segments. It is characterized from other closely related forms by the very pointed eye tubercle, elongated abdominal segment, spination of the legs and single row of long spines underneath the second tarsus, short thick hand with short fingers, and short and rather heavy neck.

#### Genus AMMOTHEA Leach

##### AMMOTHEA DISCOIDEA, new species

##### FIGURE 33, e, f

*Description*.—Body short, circular or disk-shaped, lateral processes contiguous throughout their length, anterior process very slightly separated from cephalic segment, each tipped with a pair of laterodorsal tubercles from apex of each of which usually arises a short stiff bristle; abdominal process long, slender, reaching at least to distal end of first coxal segment of posterior legs or even farther.

Proboscis long, heavy, over half as long as trunk, thickest in middle, tapering a little to anterior end, which is blunt, terminating in mouth surrounded by three lips, one dorsomedian and two latero-ventral.

The anterior or cephalic part without neck, widened anteriorly and ending on each side in a small protuberance tipped with a bristle, like lateral processes. Anteriorly, cephalic part bearing a moderately high eye tubercle, which slants slightly forward and is rounded except for a very small pointed peak. Eye tubercle bearing four eyes, which are somewhat elongated parallel to axis of tubercle and are all basal.

Cheliferi half as long as proboscis; not chelate in adult, but immature specimens show definite and well-developed chelae; basal segment or scape elongate; second segment short and almost round. Cheliferi gently bowed toward one another.

Palpi 8-segmented; first segment short, second long, third short, fourth equal in length to second; fifth, sixth, seventh, and eighth all very short, subequal, and thickly clothed with hair.

Ovigeri 10-segmented; first two segments quite stout, not much longer than wide and almost equal in length; third segment as long as segments 1 and 2 together and slenderer; segment 4 equal in length and width to 3, somewhat curved, and also armed with a few small spines; segment 6 shorter than 5, armed with very few spines; segment 7 very short, a little heavier than preceding, as wide as long, on its outer side armed with a group of four long stout spines; segment 8 equal in length to 7 but slenderer, armed dorsally with one spine; segment 9 as long as 7 and 8 together, armed with two or three scattered spines; segment 10 or terminal segment very small and difficult to separate from preceding, armed at its termination with two large spines but no claw. Ovigeri in the male considerably longer than in female; the tips of the ovigeri curled in both sexes. Small groups of eggs may be attached to the ovigeri of the male on the fourth and fifth segments; although the number of the egg groups is not constant, there are usually several; the type specimen has seven groups per ovigeri.

Legs short, about equal in length, covered with microscopic tubercles, stout, armed with scattered spines, terminating in well-developed claw and pair of strong auxiliary claws. Coxa I 0.5 mm, with a long narrow tubercle that is not quite half so long as the segment and armed distally with a short spine, situated on the posterior, dorsal, distal margin; on its anterior distal margin armed with a small tubercle from which two or three spines arise, as wide as long; coxa II 0.7 mm, armed on both sides with several spines; coxa III 0.5 mm; femur 1.5 mm, heavier from center to tip, especially swollen in female, armed distally with a short protuberance and spine; tibia I 1.4 mm, armed dorsally with several short spines; tibia II, 1.3 mm, armed dorsally with numerous short spines; tarsus I very short,

about 0.2 mm and very slender, armed distally underneath with several spines; tarsus II stout, curved ventrally, 0.7 mm long, armed dorsally with a row of short spines, ventrally in proximal part armed with three or four heavy curved spines, distally with several small spines; claw 0.3 mm long, curved, untoothed; auxiliary claws slender but over half as long as claw. Genital apertures of male occur on distinct high tubercles on ventral distal margins of second coxae of two posterior pairs of legs; genital apertures of female occur on slightly swollen areas in a position similar to male on all four pairs of legs.

Abdominal process slender, cylindrical, pointing posteriorly but slightly bent upward, about three-fourths as long as proboscis; armed near tip with a few spines.

Immature specimens possess well-developed chelae and have been found ranging in size from specimens only half as large as mature specimens to fully grown specimens. Among smaller individuals the ovigera are entirely undeveloped and are indicated only by a bud in front of anterior pair of walking legs; in large specimens ovigera almost as complete as in mature females. It seems impossible to distinguish males and females among immature specimens.

Considerable variation is noted in the external appearance of individuals of *Ammothea discoidea*, owing to differing stages of ecdysis; specimens that had not recently molted when collected possess a tougher integument and stiffer and more visible spines than those that had just molted. The living animal varies from a deep pink to white; preserved specimens lose the pink color and vary from tan to white.

*Measurements*.—Body, including proboscis, 2.8 mm; proboscis 1.1 mm; trunk 1.1 mm; abdominal segment 0.7 mm; lateral process 0.5 mm long; eye tubercle 0.25 mm high.

*Types*.—Holotype: Male specimen collected with a group of males, females, and immature specimens dredged south of McNeils Island, Puget Sound, July 24, 1934, U.S.N.M. no. 71500. Paratypes: Males, females, and immature specimens dredged off Fosdick Point, Puget Sound, July 1935; immature and female specimens dredged off Blake Island, July 8, 1935; males, females, and immature specimens dredged off Lake Hancock, August 10, 1935; males, females, and immature specimens dredged between McNeils Island and Bahl Passage, July 8, 1935; specimens from off Caldron Rock (70 meters), July 10, 1935; females dredged off Vashon Point, July 24, 1934; immature specimens dredged off Fosdick Point, July 23, 1934; males, females, and immature specimens dredged from 40 meters off McNeils Island and Bahl Passage.

*Remarks*.—*Ammothea discoidea* is most nearly related to *A. latifrons* Cole (1904, p. 263), a species that occurs around Unalaska and

the Pribilof Islands<sup>3</sup>; it agrees with *latifrons* in the sexual characters and in possessing the long, well-developed cheliferi, but differs notably in the shorter abdomen and the small size. It differs from the description of *A. longicaudata* Stimpson (1864, p. 159) from Puget Sound in having only eight segments in the palpi instead of nine and in its small size. Stimpson's description gives very few specific characters and is compiled from a single immature specimen, which should probably be placed in the genus *Ammothella* because of the 9-segmented palpi; *Ammothella longicaudata* (Stimpson) has not been collected in recent years.

*A. discoidea* is found in large numbers among hydroids of certain localities. Its limited distribution seems quite unaccountable at the present time. It has been collected only within a small range in the central part of Puget Sound off McNeils Island.

#### AMMOTHEA ALASKENSIS Cole

*Ammothea alaskensis* COLE, Harriman Alaska Expedition, vol. 10, p. 266, pl. 12, fig. 4; pl. 17, figs. 4-12, 1904.

One female specimen found off Lake Hancock, Puget Sound, July 8, 1935, dredged from 60 meters along with many specimens of *A. discoidea*. It measures only 2 mm rather than nearly 3 mm, the eye tubercle is a little larger than that figured by Cole, and the abdomen is not so heavily spined. In other respects the specimen agrees so closely with Cole's description that these differences are to be overlooked until more material is available to study the variation consistent with the species.

#### Genus PHOXICHILIDIUM Edwards

##### PHOXICHILIDIUM FEMORATUM (Rathke)

*Nymphon femoratum* RATHKE, Naturh. Selsk. Skrifter, vol. 5, p. 201, 1799. *Phoxichilidium femoratum* COLE, Harriman Alaska Expedition, vol. 10, p. 283, pl. 13, fig. 10; pl. 24, figs. 1-5, 1904.

Two females dredged south of McNeils Island, July 24, 1934; females and 3 immature specimens dredged between Shaw Island and Turn Rock, July 1, 1935; 1 female dredged from 60 meters off Lake Hancock, July 10, 1935; 1 male with eggs dredged in Hoods Canal, April 27, 1934; 1 male dredged from 70 meters off Caldron Rock, July 10, 1935.

These specimens differ considerably in size, 3.8 to 2.5 mm. Two of the males possess ovigers in which there is an indication of a sixth segment; the wall of this is not entirely complete and seems to be inarticulate.

<sup>3</sup> Schmitt (1934, p. 69), however, records this species from Monterey Bay, Calif.



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## CALIFORNIA CRUSTACEA OF THE ORDER CUMACEA<sup>1</sup>

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THE collection of cumaceans here reported upon was obtained in the vicinity of Newport, Calif., by Prof. G. E. MacGinitie, director of the Kerckhoff Marine Laboratory of the California Institute of Technology at Corona Del Mar, Calif. Newport lies in Orange County at about latitude 33°38' N.

Knowledge of the cumacean fauna of the Pacific coast of North America is so slight that every new collection from that region contributes important information. Until now only three species have been known from the coast of California: *Bathycuma* (?) *longicaudata* Calman, from San Diego, Calif.; *Diastylopsis dawsoni* S. I. Smith, ranging from Monterey Bay, Calif., to Chignik Bay, Alaska; and *Colurostylis* (?) *occidentalis* Calman, from Monterey Bay, Calif., to Oregon. Only the last of these is represented in the present collection, while each of the other seven species represented proves to be new.

The genus *Cyclaspis* was hitherto unknown from the North American-Pacific region, and the genera *Procampylaspis* and *Oxyurostylis* were unknown from the entire Pacific region. Of the latter, only the typical species, *O. smithi* Calman, which is found only on the Atlantic-American coasts from Louisiana to Casco Bay, Maine, was known.

<sup>1</sup> Translated from the German by Coates W. Shoemaker, Smithsonian Institution.

By the discovery of the new *Hemilamprops* (?) *californica*, the number of species of the group *Lamprops*+*Hemilamprops* found in the Pacific region is increased by one. Eight species had previously been described from that region, and I know of three additional new species from Russian material now in press, making a total of 12. When it is considered that from the much better investigated North Atlantic region only nine species of the group are known, to which four more from the southern seas may be added, the role that this group plays in the North Pacific region can be better appreciated.

### Genus CYCLASPIS Sars

#### CYCLASPIS NUBILA, new species

FIGURE 34

*Adult female*.—The thoracic portion of the body is nearly as long as the abdominal. The carapace approximates three-tenths of the length of the body. The ocular lobe is distinct and reaches to the end

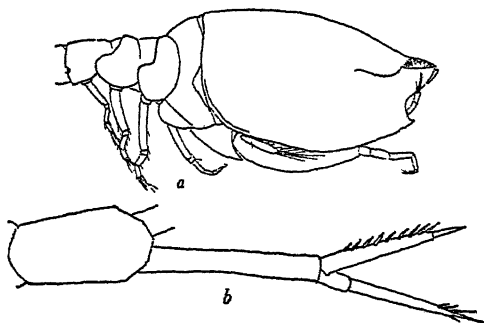


FIGURE 34.—*Cyclaspis nubila*, new species: *a*, Adult female, anterior end of body, lateral view,  $\times 15$ ; *b*, same, posterior end,  $\times 34$ . (Magnifications approximate.)

of the pseudorostrum. The eye is strongly pigmented, nearly black. Lenses are indistinctly seen only in the hinder part. Subrostral notch distinct and deep, subrostral tooth acute. The carapace is finely and sharply pitted as if pricked with a needle, a form of ornamentation that is also repeated on the second free thoracic somite.

A median carina runs the length of the carapace, and is also rather well developed on the second free thoracic somite. On the last three free thoracic somites the median carina is less well developed, and, as it approaches the posterior extremity of the abdomen, it becomes still more indistinct.

The hinder margin of the carapace and the second free thoracic somite stand in such close juxtaposition that the first free thoracic somite is visible only as a narrow band in its dorsal median portion and on each side posterior to the lower half of the hinder margin of the carapace. Here the visible portion of the first somite is somewhat wider, because the anterior margin of the second is recessed or excavate at this point.

The anterior margin of the second free thoracic segment in lateral view appears as high as the carapace. Posteriorly it falls off gradually to meet the dorsum of the third somite. Its posterior margin in dorsal view is produced to form an obtuse angle fitting into the anterior margin of the following somite, which is shaped to receive it.

The articulation between the antepenultimate and penultimate joints of the first pereopod reaches about as far forward as the tip of the pseudorostral tooth. The basis is distinctly longer than the distal joints taken together and carries no distally projecting tooth. The last three joints are to one another approximately as 9 : 10 : 6.

The uropods (fig. 34, b) are about as long as the penultimate abdominal somite. Their peduncle attains about  $1\frac{1}{4}$  times the length of the last abdominal somite. The exopod is fully two-thirds as long as the peduncle. The endopod is somewhat shorter than the exopod. On its inner margin there are about nine spines; distally it is not pointed but truncate and armed with a strong terminal spine.

*Color.*—The alcoholic specimen shows traces of its former coloring in lighter or darker brown areas. The subrostral angle is quite dark, and from it extends a narrow brown stripe, at first about parallel with and a little removed from the edge of the subrostral notch and then turning off to run down toward the ocular lobe. An indistinct brown spot is present on the mid dorsum of the posterior end of the carapace. The second and third free thoracic somites are somewhat mottled or beclouded in color but unsymmetrically so. The coloration on the last thoracic and first abdominal somites is more distinct. Finally, traces of pigmentation still persist on the first three pairs of pereopods.

*Length.*—About 6 mm.

*Occurrence.*—A single adult female, the unique holotype (U.S.N.M. no. 71437) is from off Corona Del Mar, Calif., 7 fathoms, May 17, 1933 (no. 33).

*Remarks.*—For the many and diverse species of the genus *Cy-claspis*, Calman<sup>2</sup> gives a key in which our new species falls into the same category (B, a, b, B'—b'—2) with *C. levis* G. M. Thomson. These two species possess the following characters in common (certain characters are also added here on the basis of later described species): Eye present, carapace wholly smooth, without ridges, ribs, or folds, without large tubercles, without strong teeth on the mid-dorsal carina, peduncle of the uropods not more than twice as long as the branches, basis of the first pereopod without projecting tooth at the end, carapace less than one-third as long as the entire body, basis of the first pereopod not twice as long as the distal joints taken together.

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<sup>2</sup> Trans. Zool. Soc. London, vol. 18, pt. 1, no. 1, p. 6, 1907.

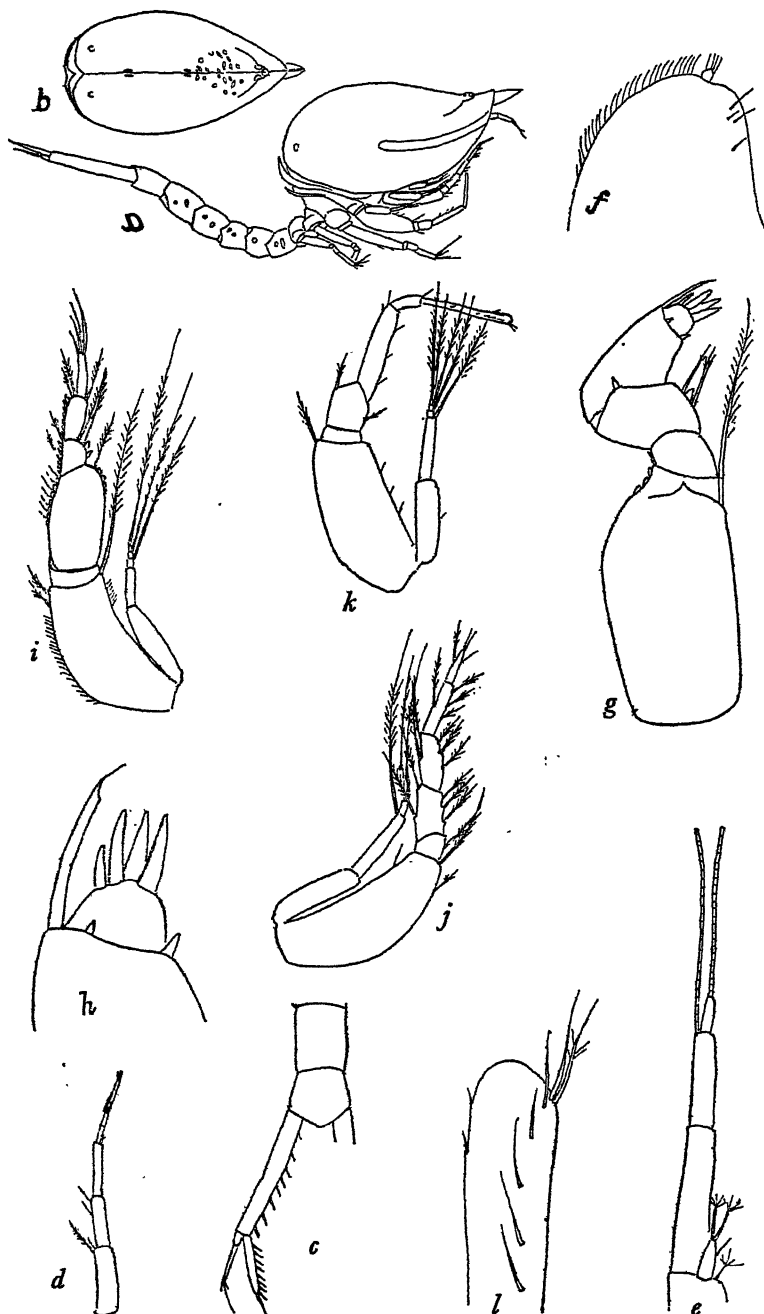


FIGURE 35.—*Campylaspis canaliculata*, new species, adult female: *a*, Lateral view,  $\times 15$ ; *b*, anterior end of body from above,  $\times 15$ ; *c*, posterior end,  $\times 22$ ; *d*, antennule,  $\times 45$ ; *e*, end of antennule,  $\times 190$ ; *f*, distal end of first maxilliped,  $\times 190$ ; *g*, second maxilliped,  $\times 114$ ; *h*, distal end of second maxilliped,  $\times 310$ ; *i*, third maxilliped,  $\times 45$ ; *j*, first pereopod,  $\times 45$ ; *k*, second pereopod,  $\times 45$ ; *l*, distal end of second pereopod,  $\times 290$ . (Magnifications approximate.)

Until now the only other species in this category has been *C. levis* Thomson, from which the new one is distinguished among other characters by the fact that the endopod of the uropods is not pointed but armed with a terminal spine. The following species of the genus likewise show a terminal spine at the end of the endopod: *carinata* C. Zimmer, *costata* Calman, *longipes* Calman, *picta* Calman, *unicornis* Calman, and *varians* Calman. These may be distinguished from the new species as follows: In *carinata*, *picta*, and *varians* the pseudorostral lobes distinctly unite in advance of the ocular lobe to form a pseudorostrum; *costata* has longitudinal ribs on the sides of the carapace; and *unicornis* has a forwardly directed tooth in the middle dorsal carina of the carapace. (The structure of the endopod of the uropod of *C. sibogae* Calman is not known. This species shows distinct ridges on the carapace.) The relative length of the carapace of *C. pusilla* G. O. Sars differs very slightly from that of *C. nubila* and also exhibits certain other similarities. The former, however, is essentially a smaller species, the length of the female with the brood pouch being 3.5 mm.

#### Genus CAMPYLASPIS Sars

##### CAMPYLASPIS CANALICULATA, new species

##### FIGURE 35

*Female*.—The thoracic portion of the body is almost as long as the abdominal, including the peduncle of the uropod. Viewed from above (fig. 35, *b*), the carapace is moderately pointed anteriorly. There is no subrostral notch. From the pseudorostral margin a relatively narrow but distinct furrow or groove, the margins of which are not developed as folds, runs backward and somewhat upward for about half the length of the carapace. On either side, near the hinder margin of the carapace, is a tiny pit or depression. Otherwise the carapace is entirely smooth, without sculpture. On the well-developed ocular lobe one sees a distinct median lens and two more or less distinct lateral lenses. A fine suture is evident along the median line of the carapace; this is also present on the abdomen. Its course, however, is not quite straight, but in very flat irregular curves. The roundish or elongate refractive flecks on the surface of the carapace that occur so often in members of this genus are present in this species also. There is a patch of them behind the frontal lobe. Alongside the median suture in the posterior third of the carapace there is an elongated spot or fleck. Similar small spots are also present on the abdominal somites.

The first free thoracic somite, as in a number of other species of the genus, forms a median, lobelike, pointed projection, turned forward and fitting into a corresponding notch in the posterior margin

of the carapace. A similar projection occurs also on the second thoracic somite. These projections, especially the first, are of considerable length.

The antennule (fig. 35, *d*, *e*) is slender. The first article of the peduncle is somewhat longer than either of the other two, which are subequal. The accessory flagellum is, as usual, very small.

The terminal joint of the first maxilliped (fig. 35, *f*) is very tiny. The basis of the second maxilliped (fig. 35, *g*, *h*), ventrally near the distal end projects as an angular dentiform edge, which, however, does not carry over to the outer margin. It probably represents the line of fusion between the basis and ischium. The outer margin shows a few low denticles near its end. On the outer margin of the merus there are a few similar denticles. The carpus has a strong tooth on its inner margin, and anteriorly a somewhat weaker tooth on the ventral side. The anterior margin of the propodus has two small teeth below and two bristles above. At the distal end of the outer margin there is a long powerful spine of peculiar structure. At first it diminishes gradually toward the tip, and then near its extremity undergoes a sudden contraction on the inner side, so that the spine distally forms a fine bristlelike structure that surpasses the terminal spines of the dactyl. At the end of the dactyl are four strong spines, a shorter one externally, with three longer ones on the inner side; of these the middle spine stands somewhat out of the line of the series, a little more toward the dorsal side than the others.

The basis, ischium, and merus of the third maxilliped (fig. 35, *i*) are broad; the following joints are slenderer. The basis is noticeably shorter than the distal portion of the limb. The inner margin of the merus is practically straight. The distal half of this inner margin is furnished with a row of low denticles. The outer edge likewise carries a few denticles in its distal portion. The carpus has a row of denticles on the inner margin and two small denticles on the outer. The propodus exhibits denticles only on the inner margin, while the dactyl is devoid of them.

The basis of the first pereopod (fig. 35, *j*) is shorter than the distal part of the limb. The carpus and the propodus are of nearly equal length and longer than the dactyl. None of the joints has marginal denticles.

Of the last three joints of the second pereopod (fig. 35, *k*, *l*), the carpus is scarcely shorter than the dactyl, while the propodus, as usual, is short, only about half the length of either of the other two joints. The dactyl is peculiar in not diminishing toward its end, indeed widening out somewhat instead. The distal extremity is rounded off and is without terminal bristles. A few bristles, however, do occur just before the end of the joint on its inner margin.

The peduncle of the uropods (fig. 35, *c*) is about as long as the last two abdominal segments taken together. On its inner margin there are about seven spines. The endopod is about half as long as the peduncle and on its inner margin also carries about seven spines. The exopod is, as usual, slenderer and shorter than the endopod.

*Length*.—About 4 mm.

*Occurrence*.—Between Balboa and Corona Del Mar, Calif., 7–15 fathoms, March and May 1933 (no. 28), two specimens, a female with brood pouch and an adult female (holotype, U.S.N.M. no. 71438), together with two specimens of *Oxyurostylis pacifica*.

*Remarks*.—The species is readily distinguished from all other hitherto known species by the hollowed-out groove on its carapace. *Campylaspis sulcata* has a similar groove, but it is wider, with its margin either side forming more or less of a ridge or fold.

#### Genus PROCAMPYLASPIS Bonnier

##### PROCAMPYLASPIS species

*Occurrence*.—Off Balboa, Calif., 15 fathoms, February 16, 1933 (no. 31), a female with brood pouch. The specimen undoubtedly represents a new species. The carapace has on each side a wide longitudinal groove extending about two-thirds the length of the carapace. The dorsum between the two grooves carries a number of not very pronounced tubercles. Three larger but much flattened tubercles are present close to the posterior margin of the carapace, the largest in the middle between the smaller lateral ones. The specimen is somewhat damaged and is thickly encrusted with sand, which cannot be removed without further harm. For this reason I refrain from basing the description of a new form upon it and leave it unnamed.

#### Genus HEMILAMPROPS Sars

##### HEMILAMPROPS (?) CALIFORNICA, new species

##### FIGURE 36

*Female with brood pouch*.—The thoracic portion of the body is somewhat longer than the abdomen, with the exception of the telson. The carapace is as long as the first four free thoracic somites taken together. In lateral view its anterior and upper margins appear to meet at right angles. From above (fig. 36, *b*) it appears anteriorly broadly truncate. A subrostral notch is scarcely perceptible. On either side of the carapace is an arched fold, which, beginning at the pseudorostral margin, runs obliquely backward and upward and, bending around in a symmetrical turn, back anteriorly to merge with the median carina found on the frontal lobe. The ocular lobe is distinct and large. On it are seven lenses, one in the center,



with six disposed in a ring about it. The pseudorostral lobes are juxtaposed but for a very short distance in front of the ocular lobe.

The telson (fig. 36, *c*) is longer than the penultimate somite of the abdomen but not so long as the last two somites taken together. Distally there are three or four spines on the lateral margin; apically there are three spines, of which the median is much longer than either of the lateral ones. Below, and somewhat external to the two lateral spines, there are two other long, practically bristlelike spines.

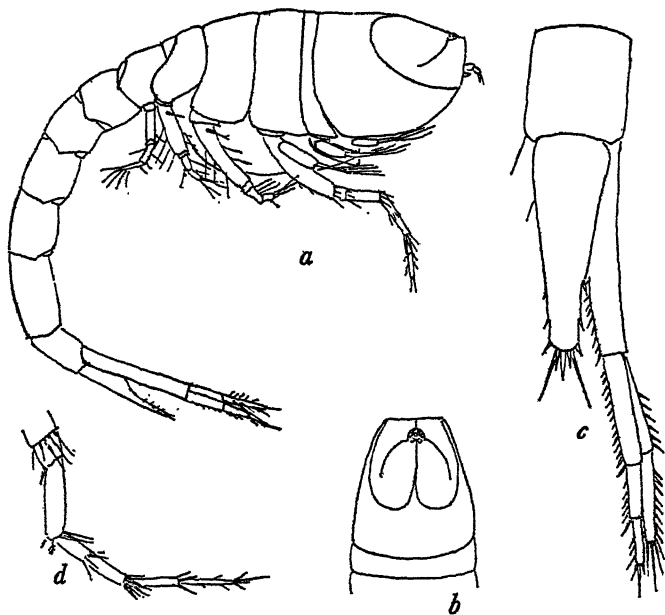


FIGURE 36.—*Hemilamprops californica*, new species, female with brood pouch: *a*, Lateral view,  $\times 19$ ; *b*, anterior end of body from above,  $\times 19$ ; *c*, posterior end,  $\times 33$ ; *d*, distal end of second pereopod,  $\times 33$ . (Magnifications approximate.)

The first pereopod was lacking in all the specimens at hand. The second pereopod (fig. 36, *d*) is moderately long. The length of its three distal joints is approximately as  $19 : 14 : 12$ .

The peduncle of the uropods (fig. 36, *c*) extends very slightly beyond the telson. The endopod is about as long as the peduncle. The exopod shorter. Of the three joints of the endopod, the first is somewhat longer than the other two taken together; the terminal joint is somewhat shorter than the penultimate. On the inner margin of the peduncle and of the endopod there is a relatively dense armature of spines; on the inner margin of the exopod setae, on the outer margin spines.

*Length*.—One specimen has a length of about 8 mm. The other two are smaller, about 6 and 5.5 mm long, respectively.

*Occurrence.*—Off Corona Del Mar, Calif., 7 fathoms, May 17, 1933 (no. 32), a female with brood pouch, together with a specimen of *Colurostylis* (?) *occidentalis*. Between Balboa and Corona Del Mar, 17-33 fathoms, May 17, 1933 (nos. 26, 30), two females with brood pouches. Holotype, U.S.N.M. no. 71439.

*Remarks.*—Lacking a male, I cannot say with certainty whether the species belongs to *Hemilamprops* or *Lamprops*. As the suborbital notch is but slightly developed, I place it with *Hemilamprops* with a question mark. (*Lamprops carinata* Hart tends to bridge the gap between the two genera. The male has no pleopods—a *Lamprops* character—but has well-developed and not shortened antennal flagella—a *Hemilamprops* character.)

In possessing a single oblique fold on the carapace, the new species agrees with *Hemilamprops uniplicata* G. O. Sars and with *Lamprops* (?) *beringi* Calman. Both, however, lack the reverse forwardly directed branch of this fold. The armature of the telson, as well as the relative length of the three distal joints of the second pereopods, is also different. In *L.* (?) *beringi*, moreover, there is a distinct subrostral notch with an acute-angled subrostral tooth.

#### Genus DIASTYLIS Say

##### DIASTYLIS CALIFORNICA, new species

##### FIGURE 37

*Female with brood pouch.*—The thoracic portion of the body is somewhat longer than the abdominal but shorter than the abdomen and telson together. The abdominal portion is quite sharply set off from the broader and higher thoracic portion.

On the ocular lobe three indistinct lenses may be distinguished. There is a distinct subrostral notch. The subrostral angle is but narrowly rounded.

The margin of the subrostral notch carries several anteriorly directed plumose setae. The margin of the suborbital angle is only indistinctly denticulate, although the margin of the carapace a little farther back (behind carina no. 2 described below) has a short row of long slender teeth.

The carapace is pronouncedly and characteristically sculptured, showing strong elevated ridges or keels, enclosing between them noticeably excavate or depressed areas. At two places on either side of the carapace, three such keels run together. The angles (in the stereometric sense) thus formed by these keels rise well above the general surface of the carapace, almost forming blunt teeth. One of the angles (no. 1) lies just before the end of the frontal lobe but at some distance from it; the second (angle no. 2) is a little distance behind the end of the frontal lobe. From angle

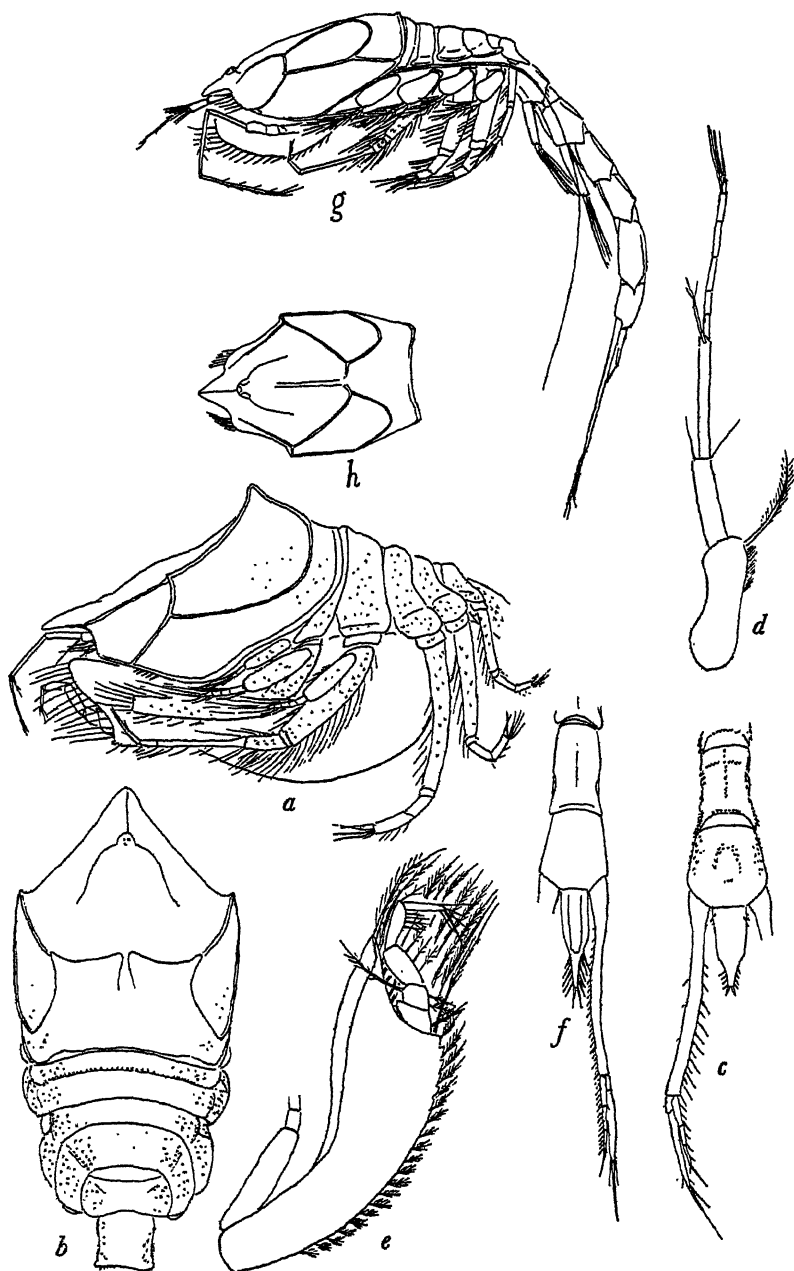


FIGURE 37.—*Diastyllis californica*, new species: *a*, Female with brood pouch, anterior end of body, lateral view,  $\times 13$ ; *b*, female with brood pouch, anterior end of body from above,  $\times 13$ ; *c*, female with brood pouch, posterior end,  $\times 13$ ; *d*, female with brood pouch, antennule,  $\times 33$ ; *e*, female with brood pouch, third maxilliped,  $\times 25$ ; *f*, male in nuptial dress, posterior end,  $\times 13$ ; *g*, male in nuptial dress, lateral view,  $\times 9$ ; *h*, male in nuptial dress, carapace from above,  $\times 9$ . (Magnifications approximate.)

no. 1 a ridge or keel (keel no. 1) runs obliquely forward and terminates about at that point where the pseudorostral margin, in forming the subrostral notch, curves downward; another ridge (keel no. 2) runs obliquely outward and forward in a flat anteriorly open curve onto the ventral margin of the carapace, which it strikes a little distance behind the subrostral angle. Keel no. 3 runs obliquely backward and upward and forms a connecting ridge or keel between angles nos. 1 and 2. Running out from this angle no. 2 are also the following ridges or keels: Keel no. 4 at first runs posteriorly and then, bending outward and forward, in the latter part of its course runs practically parallel to the lower margin of the carapace but at a little distance removed from it; finally it runs up against keel no. 2 and ends at that point. Keel no. 5, forming a very flat, anteriorly open curve, extends nearly perpendicularly to the median line; it does not, however, meet its counterpart on the opposite side of the carapace, as a narrow gap or interval intervenes between the two. At this point, within the gap, the surface of the carapace is deeply impressed; this impression is briefly continued backward. In lateral view the dorsal contour of the carapace in advance of keel no. 5 suddenly slopes steeply, yet evenly, downward to the pseudorostrum.

The telson (fig. 37, *c*) is as long as the last abdominal somite, or the equally long penultimate one. In the preanal portion of the telson the lateral margins converge but slightly; on the other hand, the postanal portion, which is a little more than half as long as the preanal, narrows abruptly. On each side of the postanal portion of the telson there are about four lateral spines in addition to the terminal pair.

The antennule (fig. 37, *d*) is slender and exceeds the pseudorostrum by the last joint of its peduncle.

The basis of the third maxilliped (fig. 37, *e*) distally is markedly broadened and, moreover, its outermost portion is not inconsiderably produced; its outer margin is dorsally turned upward a little. As the "mouth-field" is considerably narrower than the combined bases of the two maxillipeds, these at their line of contact form a roof, the angle of whose ridge is higher than normal. As a consequence, more of the third maxilliped is to be seen in lateral view (fig. 37, *a*) in this species than is usually the case. Not one of the specimens possessed a complete first pereopod. One female, however, had a first pereopod complete on the inner side except for a portion of the dactylus. The distal extremity of this particular limb is long and slender; carpus less than half as long as the basis; propodus clearly longer than the carpus. The second pereopod also is slender; last

three joints taken together are longer than the basis; last two joints taken together not quite two-thirds as long as the carpus; the dactyl longer than propodus. There are no rudimentary exopodites on the third and fourth pereopods.

The uropods (fig. 37, *c*) are long and slender. The peduncle is longer than the last two abdominal somites taken together. Its inner margin is sparsely spined; spines somewhat variable in size. The endopod is about as long as the telson; the exopod somewhat longer. The three joints of the endopod vary but slightly in length, and carry isolated spines on their inner margins.

The integument is roughened practically throughout with tiny chitinous processes or projections. These vary in size, at times even assuming the character of fine, small teeth, as on the posterior region of the carapace and also on the sides of the free thoracic and abdominal somites, as well as on the outer surface of the proximal portions of the pereopods.

*Length*.—About 9 mm.

*Male in nuptial dress* (fig. 37, *f-h*).—The differences in the body form and in the development of the extremities usually found between the males and females within the genus occur here also; the three lenses are more distinct on the ocular lobe, the setae in the subrostral notch are stronger and more numerous, and the area about the subrostral angle is clearly denticulate. On the other hand, the row of denticles on the margin of the carapace behind keel no. 2 is lacking. The keels found on the carapace of the female are present but are not nearly so high or so strongly developed, nor are the areas between them so deeply excavated. Their placement is also somewhat different: Angle no. 2 is moved farther backward and substantially nearer the median line than in the female; keel no. 1 eventually disappears anteriorly without reaching the edge of the carapace; keel no. 5 is very short. It eventually disappears toward the median line and here merges with an indistinct longitudinal keel, which runs from about the mid length of the frontal lobe to the point of juncture with keel no. 5 in the median line of the carapace. From the forwardly turned branch of keel no. 4 and, in fact, at about the point where the turn is completed, originates another keel that runs to the posterior edge of the carapace. This keel is entirely absent in the female. It corresponds with the forward-running branch of keel no. 4, of the "lateral line", which so frequently is found in the male in the family Diastylidae.

The difference in length between preanal and postanal portions of the telson (fig. 37, *f*) is not so pronounced as in the female, while the telson is proportionately longer and slenderer. It attains the length of the penultimate abdominal somite and is, like it, clearly

longer than the last somite. In addition to two terminal spines, it carries on either side of its postanal portion about five fairly long lateral spines.

The carpus of the first pereopod is noticeably shorter than the propodus and the latter is clearly shorter than the dactyl.

The peduncle of the uropod is about twice as long as the telson. The exopod is clearly shorter than the telson and the endopod is somewhat shorter than the exopod. The three joints of the endopod are successively somewhat shorter from first to last. The spines on the inner side of the peduncle and endopod are weaker but more numerous than in the female.

The integument of the male is also roughened but not so much as in the female.

*Length*.—About 12 mm.

*Occurrence*.—Between Balboa and Corona Del Mar, Calif., 10–67 fathoms, November 25, 1932, to July 1, 1933 (no. 27), three females, one the holotype (U.S.N.M. no. 71440), with brood pouch, and two adults in poor condition and incomplete; off Balboa, Calif., 66 fathoms, March 17, 1933 (no. 29), a male in nuptial dress; off Balboa, between 15 and 66 fathoms, April 10, 1933 (no. 34), one male in nuptial dress.

*Remarks*.—The peculiar sculpturing of the carapace in both sexes distinguishes this new species from all other representatives of the family. In the form of its telson it shows certain relationships to the genus *Makrokyliindrus*; both have an almost cylindrical preanal portion distinctly longer than the postanal, which carries a few or no lateral spines. In species of *Makrokyliindrus*, however, the telson is longer than the peduncle of the uropod, or at least nearly as long (with the exception of *M. acanthodes* Stebbing). Furthermore, a more or less thick armament of the carapace is the rule among these species, and spines exist at least on the pseudorostrum, especially on its anterior portion. In the species before us the carapace is indeed roughened with fine granulations or tiny denticles, but on its pseudorostrum this roughness is least developed and is practically lacking on its anterior portions. Since to me the relationship with *Makrokyliindrus* appears slight, I have refrained from placing this new species in *Makrokyliindrus*, as I at first had tentatively intended.

A similar form of the telson also occurs in the genus *Paradiastylis*, but here, too, no closer relationship is indicated, for the male in nuptial dress lacks the strikingly widened base of the pereopods, which is so characteristic of *Paradiastylis* and *Dimorphostylis*.

Genus *DIASTYLOPSIS* Smith*DIASTYLOPSIS TENUIS*, new species

## FIGURE 38

This new species is so extraordinarily closely related to *Diastylopsis dawsoni* S. I. Smith that I shall limit the description in the main to a differential diagnosis. The body, especially the abdominal portion, is slenderer. The subrostral notch is indeed distinct, yet not so deep, owing to the fact that the subrostral angle is not so produced as to form a definite tooth. It is only denticulate, like the anterior margin of the carapace behind it. The oblique lines on the carapace and frontal lobe are present, but only the first line on the carapace is well developed throughout. The others are very weak and often scarcely or not at all perceptible. The layout of the lines also is somewhat different. The first line extends laterally somewhat nearer the margin of the carapace than indicated in Calman's drawing of *dawsoni*. The second line has the same position as in *dawsoni* but forms a continuation of the first line of the frontal lobe. This, therefore, runs farther forward than in *dawsoni*. The second line of the frontal lobe lies about in the position of the first in *dawsoni*, and therefore not on the hinder end of the frontal lobe. The third carapace-line extends in the direction of the posterior angle of the frontal lobe and thus lies more posteriorly than in *dawsoni*.

The ventral portion of the second free thoracic segment is considerably longer; anterior and posterior margins (exclusive of the articular membranes) are approximately parallel, whereas in *dawsoni* they distinctly converge ventrally. The notch in the anterior lateral margin of this somite is narrower than in *dawsoni*.

On the penultimate thoracic sternite of *dawsoni* there is a single tooth; on the last there are two teeth close together; there is also one tooth on the first abdominal sternite. Our new species has no teeth on the penultimate thoracic and the first abdominal sternite; only the last thoracic sternite bears an unpaired tooth. The posterior lateral margins of the abdominal somites are armed with a few isolated denticles.

The telson is slenderer than in *dawsoni*. Its length is about three-fourths of the last abdominal somite, which itself also is much slenderer than in *dawsoni*. Besides the two terminal spines, the telson has only two or three pairs of lateral spines; in *dawsoni* the number is greater.

The third maxilliped, as in *dawsoni*, shows a widening of the basis distally. On the other hand, our species has only one weak denticle on the inner end of the basis, not a strong projecting tooth. The ischium does project outwardly, ending bluntly, but not actually

dentiform. (The first two pairs of pereopods of either side in all the specimens were incomplete.)

The uropod-peduncle is only a little longer than the last abdominal somite and extends beyond the telson by about a third only of its own length, not by half of its length as in *dawsoni*. The subequal branches attain about two-thirds the length of the peduncle, not, as in *dawsoni*, a good half of the peduncle length. There are fewer spines on the inner margin of the peduncle and endopod than in *dawsoni*.

*Length*.—The female with brood pouch is about 9 mm, whereas in *dawsoni* the length of the adult female is about 14.5 mm.

*Occurrence*.—Off Corona Del Mar, Calif., 20 fathoms, summer of 1933 (no. 26), an adult female and three females with brood pouches, one the holotype (U.S.N.M. no. 71441).

*Remarks*.—Beneath the chitin of the carapace and also at intervals in other parts of the body a distinctive structural peculiarity is manifest in the shape of more or less numerous, chiefly circular, strongly refractive flecks of varying size, which at times may coalesce to form larger irregular areas. I consider this phenomenon here to be an artificial condition resulting from the method of preservation employed.

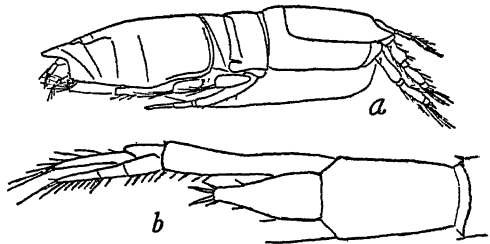


FIGURE 38.—*Diastylopsis tenuis*, new species, female with brood pouch: *a*, Anterior end of body, lateral view,  $\times 9$ ; *b*, posterior end,  $\times 25$ . (Magnifications approximate.)

#### Genus OXYUROSTYLIS Calman

##### OXYUROSTYLIS PACIFICA, new species

#### FIGURE 39

*Female with brood pouch*.—The thoracic portion of the body is almost as long as the abdominal, the telson excepted. Seen from above, the carapace narrows anteriorly more regularly and evenly than in the typical species, *smithi* Calman. The subrostral notch is more developed than in *smithi*. The subrostral angle is rounded. The surface of the carapace and of the free thoracic sternites is rough, being thickly beset with very fine denticles. Only the anterior portion of the pseudorostral lobes is free of them. Two somewhat stronger denticles stand side by side in front on the ocular lobe. Two oblique impressions extend over the frontal lobe, so that in lateral view two steplike offsets are apparent. These, together with the fine denticulation of the carapace, make it appear as if there are two oblique rows of denticles on the frontal lobe.



The telson is longer than the last abdominal somite and somewhat shorter than the penultimate. On either side it carries three or four spines. The somewhat produced posterior angle of each of the two anal flaps is armed with a long bristlelike spine.

The antennule is long and slender and exceeds the tip of the pseudorostrum by the greater part of the last joint of its peduncle.

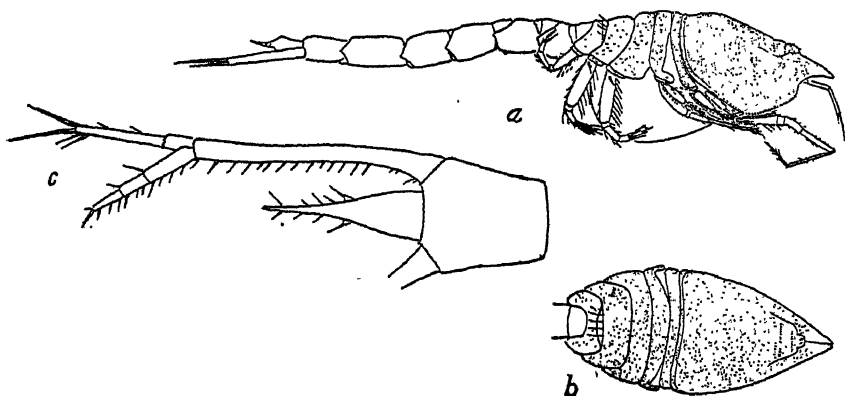


FIGURE 39.—*Oxyurostylis pacifica*, new species, female with brood pouch: a, Lateral view,  $\times 13$ ; b, anterior end of body from above,  $\times 13$ ; c, posterior end,  $\times 33$ . (Magnifications approximate.)

The first pereopod is long and slender and exceeds the tip of the pseudorostrum by a little more than its last two joints. Of the last three joints, the penultimate is the longest, the antepenultimate is somewhat shorter, and the last is only a little more than half as long as the penultimate.

The peduncle of the uropod exceeds the tip of the telson by almost one-third of its length. On its inner margin there are about 16 fine spines. The exopod is about as long as the endopod and attains almost half of the length of the peduncle. Of the three joints of the endopod, the first is the longest, the last is somewhat shorter, and the middle one slightly shorter yet. On the inner margin of the three joints there are, respectively, 4, 3, and 3 spines.

*Length*.—About 7 mm.

*Occurrence*.—Between Balboa and Corona Del Mar, Calif., 7–15 fathoms, March and May 1933 (no. 28), two females with brood pouches, one the holotype (U.S.N.M. no. 71442), accompanied by two specimens of *Campylaspis canaliculata*.

*Remarks*.—The species differs so fundamentally from *O. smithi*, the heretofore unique representative of the genus, that there is no possibility of confusing the two.

## Genus COLUROSTYLIS Calman

## COLUROSTYLIS OCCIDENTALIS Calman

The specimens agree well with Calman's description except that the tip of the terminal spine of the endopod of the uropod extends nearly to the end of the exopod, whereas, according to Calman, it falls somewhat short of it.

*Occurrence*.—Off Balboa, Calif., 33 fathoms, May 17, 1933 (no. 30), an adult male, in company with two specimens of *Hemilamprops* (?) *californica*; off Corona Del Mar, 7-20 fathoms, May 1933 (nos. 26, 33), two adult females and three females with brood pouches.





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A COMPARISON OF THE SHALLOW-WATER SPONGES NEAR  
THE PACIFIC END OF THE PANAMA CANAL WITH  
THOSE AT THE CARIBBEAN END

By M. W. deLAUBENFELS

*Pasadena, Calif.*

DURING the summer of 1933 I made a study of the intertidal sponge fauna at each end of the Panama Canal.<sup>1</sup> Specimens were collected from intertidal waters or from waters barely below low tide, entirely without dredging. The method most frequently employed was wading and collecting by hand, but in some cases an ordinary garden rake was used from a rowboat.

The sponges of the deeper ocean differ radically from those in intertidal and shallow waters. This has been well brought out by various authors, particularly by Burton (1928). Seldom do sponges from one of these habitats venture over into the other. In general the sponges of the deeper waters of one ocean are related to those in other oceans from similar depths rather than to the adjacent shallow-water forms. The latter are likely to show more regional or local specializations than are sponges from greater depths. It was therefore deemed more important to compare the shallow-water sponges from the Atlantic end of the Panama Canal with those from the Pacific end than to make any effort to collect sponges from deeper waters farther out on either side of the isthmus.

<sup>1</sup> Thanks are due to Dr. James Zetek, of the U. S. Bureau of Entomology and Plant Quarantine, and to various other officials connected with the Government staff in the Panama Canal Zone who made it possible to carry on the collecting and locate suitable places for finding sponges, and to officials of the U. S. National Museum, especially Dr. Alexander Wetmore and Dr. Waldo L. Schmitt, for help and cooperation.

There are various reasons for believing that shallow-water sponges attain distribution laterally rather slowly, or at least that they are profoundly restrained by environmental barriers. In 1932 (de Laubenfels, 1932) I found considerable difference between the coastal sponges of central and southern California, and I can report subsequent (as yet unpublished) investigation in the field indicating even greater differences between the sponges of California and those of the coast only a few hundred miles north of that State, and similarly great differences between the sponges of California and Lower California. At the Pacific end of the Panama Canal there are tremendously high tides and at the Atlantic end almost no tides at all, whereas at the Atlantic end the ocean temperature is considerably higher than at the Pacific. A great difference between the faunas of the two regions was therefore to be expected. Such a difference might be due to the different ecological conditions or to independent evolutions during a geologically long period of separation. Similarities between the faunas of the two regions would be less easily explained. A marine connection until recent times might be assumed, although other reasons for this assumption are scanty. Perhaps throughout whole geologic ages sponge species neither vary much (in an evolutionary sense) nor perish as species, nor migrate away from their established locations.

Sixteen species of sponges were collected at or near the Pacific end of the Panama Canal, and 21 species were taken at the Atlantic end. Ten species were found only on the Pacific side and 15 only on the Atlantic, while six occurred in both localities. Of these six, only two are cosmopolitan; four are distinctive of this part of the world!

The Porifera of the Caribbean end show close relationship to the West Indian fauna. An astonishing number of them were new species, no less than seven, or 33 percent. In general the Pacific coasts of Central and South America have been exceedingly little studied, and it might be expected therefore that more new species would have been found in that region, but such was not the case. Only five species on the Pacific coast proved to be new, again a third of the number collected. Searching over the rocks exposed at low tide at Panama City yielded nine species and proved astonishingly similar to collecting near Plymouth, England. Four out of the nine—*Haliclona permollis*, *Halichondria panicea*, *Microciona atosanguinea*, and *Oscarella lobularis*—are forms common to both localities. Of other species occurring nearby, *Toxadocia proxima* is Arctic, *Pseudosuberites sulcatus* is Antarctic, and *Aplysilla glacialis* is both Arctic and sub-Antarctic.

Attention is called particularly to the dissimilarities between the Panama sponge fauna and that of the Pacific coast of North America in general. Of the sponges recorded from California, at least 11 per-

cent are also recorded from Puget Sound, 1,200 kilometers north, but this latter area has been less intensively studied; of a collection I made in that region in the summer of 1931, 62 percent are sponges occurring also in California. Of a collection from Lower California, nearly 1,000 kilometers south, 36 percent are species occurring also in California. From the Pacific coast of Panama, in contrast to the 62 percent and 36 percent, only 19 percent are species occurring also in California, and every one included in the 19 percent is a cosmopolitan species, not to be regarded as characteristic of any one locality. The Pacific coasts of Panama, judged from their sponge fauna, show not a trace of zoogeographical connection with those of North America but do show a little with those of Europe and with the polar regions and more yet with that small fraction of the West Indian fauna that occurs on the Caribbean coast of Panama, and finally contain a rather large proportion of species peculiar to the locality. How this compares with the west coast of South America remains to be seen.

## DESCRIPTION OF PACIFIC COAST SPECIES

### Genus *APLYSILLA* Schulze

#### *APLYSILLA GLACIALIS* (Merejkowsky)

This species is represented in the collection by U.S.N.M. no. 22211. It was found growing on wood in Balboa Harbor, beneath one of the piers. It is a thin encrustation, was rosy red in life, and is soft and fleshy; the conules are about 1 mm high and 2 to 4 mm apart. The eurypylous flagellate chambers vary from  $30\mu$  by  $60\mu$  to  $55\mu$  by  $105\mu$ . The dendritic ascending fibers average about  $50\mu$  in diameter and arise from an extensive basal spongin plate.

The specimen is typical of the species, which was originally described from the Arctic as *Simplicella glacialis* by Merejkowsky (1878, p. 264) and later recorded from Australia by Lendenfeld (1889, p. 706). I (deLaubenfels, 1932, p. 125) recorded it from California, erroneously giving credit for the authorship to Dybowsky (1880, p. 65), in which reference it appears to be a new species, but actually it had been previously described. Thiele (1905, p. 489) recorded it from the sub-Antarctic, with the opinion that his specimen was conspecific with that of Lendenfeld but not with that from the Arctic. He therefore established a new name, *Aplysilla lendenfeldi*, for the specimens south of the Equator. There seems to be no good reason for the establishment of this new name, and it is here proposed that *glacialis* be retained for the entire species. The point was made that the Arctic specimen had fewer oscules than the others and that these had somewhat raised collars around them. This is almost certainly a reaction to the current, or a lack thereof, and has little if any taxonomic value. See Bidder (1923).

The Panama sponge now being described shows no evident oscules, probably as a result of abundant current near its location, and may be regarded as typical of the race that extends from the Arctic to the Antarctic.

Genus *HALICLONA* Grant

*HALICLONA PERMOLLIS* (Bowerbank)

This species is represented in the collection by U.S.N.M. no. 22200, found growing on the extensive rocky tide flats at Panama City. It is a thin crust, drab to violet, mediocre in consistency, and without any dermal specialization. The oscules, 2 to 3 mm in diameter, are surrounded by raised collars 3 mm high. The endosome is an isodictyal reticulation of oxeas  $7\mu$  by  $130\mu$ .

This cosmopolitan species has frequently been known under the specific name of *cinerea* (Grant), but Burton (1934) chooses as the lectotype of Grant's *Spongia cinerea* a specimen that is an *Adocia*. It therefore becomes necessary to apply Bowerbank's name of *permollis* to the species, which is a typical *Haliclona*. It is well characterized by its violet color, except where environmental factors interfere with it, perhaps by causing damage, in which instances a whole range of colors tending toward drab results. Bowerbank (1866, p. 278) founded the name as *Isodictya permollis*. I have transferred it to the genus *Haliclona* (de Laubenfels, 1936, p. 40).

*HALICLONA COERULESCENS* (Topsent)

This species is represented in the collection by U.S.N.M. no. 22240, from the Atlantic coast of Panama, and also (less typically) by nos. 22250, 22219, and 22208, from the Pacific coast. The Panamanian specimens are basically encrusting, but cylindrical or lamellate processes commonly grow up from the base. The color is typically blue in life, but where in some ways interfered with by the environment it tends toward drab. The consistency is mediocre, and the surface is comparatively even, with no special dermal skeleton at all. The pores are about  $200\mu$  in diameter and occur about two to the square millimeter. The oscules vary from 1 to 2 mm in diameter and occur very irregularly. The indications are that where the current passing the sponge is insufficient, the more evident oscules occur. The endosome is an isodictyal reticulation of oxeas varying from  $5\mu$  by  $120\mu$  commonly to  $6\mu$  by  $150\mu$  and rarely to  $9\mu$  by  $175\mu$ .

This species was described as *Reniera coerulescens* by Topsent (1918, p. 537) from the West Indies. It is here transferred to the genus *Haliclona*. The Panama specimens do not differ to any significant extent from Topsent's specimens. This is one of the most characteristic species of the Canal Zone. It was found growing intertidally on rocks near Panama City, on wood beneath the piers at

Balboa Harbor, and intertidally on rocks at Taboga Island, all on the Pacific side. On the Atlantic side it was found growing intertidally on the coast at Fort Randolph, and one macerated specimen was found cast on the beach at Fort Sherman. The distinctive blue color and the ease with which a lamellate form is assumed are perhaps its most characteristic features.

Genus *ADOCIA* Gray

*ADOCIA CINEREA* (Grant)

The specimens thus identified are represented in the collection by U.S.N.M. no. 22242, collected intertidally at Fort Randolph at the Atlantic end of the canal, and no. 22210, from one of the piers in Balboa Harbor at the Pacific end. The characteristic color in life appears to be a beautiful lavender, but as in the case of *Haliclona permollis* environmental factors may alter this in the direction of drab. The consistency is crisply friable. The endosome is smooth and is provided with a special reticulation of spicules, which, however, are just like those of the endosome. They make a beautiful isodictyal pattern, the apertures of which, about  $300\mu$  in diameter, are to be interpreted as pores,  $500\mu$  apart, center to center. The oscules, which are 2 to 3 mm in diameter, are usually on slightly raised processes, but curiously enough are not always terminally placed. The endosome is an isodictyal reticulation of oxeas about  $10\mu$  by  $150\mu$  to  $13\mu$  by  $200\mu$ .

This is not the cosmopolitan sponge frequently referred to in the literature as *Reniera cinerea*, but it bears a superficial resemblance to it and may or may not have been confused with it by earlier authors. Too little attention has been paid to the precise characters of the dermis of sponges. Reinvestigation of museum specimens and further collection may prove that *Adocia cinerea* is as nearly cosmopolitan as is *Haliclona permollis*, the species frequently referred to as *Reniera cinerea*. Both were originally described from European waters, the former as *Spongia cinerea* by Grant (1827, p. 204). It was transferred to *Adocia* by Burton (1934, p. 535).

Genus *TOXADOCIA* de Laubenfels

*TOXADOCIA PROXIMA* (Lundbeck)

This amorphous sponge is represented in the collection by U.S.N.M. no. 22222. It was collected intertidally on the rocks at Taboga Island near the Pacific entrance to the Panama Canal. In life it was a pretty violet and very soft. The surface is even. There is an isodictyal special dermal skeleton, not, however, containing any special sort of spicules, nor is it readily detachable. The pores are barely visible to the naked eye and occur about two to the square millimeter. The oscules are two in number, about 1.5 mm in diam-



eter, and have about them raised collars over 2 mm high. The endosome is an isodictyal reticulation of oxeas about  $6\mu$  by  $140\mu$ , among which occur toxiform microscleres  $2\mu$  by  $80\mu$ .

This specimen differs in no significant respect from that Arctic species described as *Gellius proximus* by Lundbeck (1902, p. 70). It is noteworthy that several of the species occurring near Panama City, less than  $10^\circ$  from the Equator, should have as their closest relatives Arctic or Antarctic species.

#### ZETEKISPONGIA, new genus

*Diagnosis*.—Family Phorbasidae. Structure more reticulate than plumose; special diactinal ectosomal spicules associated with special diactinal endosomal ones of another sort; arcuate chelas and sigmas for microscleres.

*Genotype*.—*Zetekispongia zonea*, new species.

The generic name is given in respect to the eminent zoologist, Dr. James Zetek, of the United States Department of Agriculture, Balboa, Canal Zone.

#### ZETEKISPONGIA ZONEA, new species

##### FIGURE 40

*Holotype*.—U.S.N.M. no. 22215.

The species is also represented in the collection by U.S.N.M. no. 22223. It was found abundant intertidally on the rocks of Taboga Island, near the Pacific entrance to the Panama Canal. The color in life was a characteristic reddish orange, which fades little in preservatives; this is quite unusual. The consistency is soft, slightly spongy. The surface is coarsely tuberculate, with lumps about 1 mm high and several millimeters wide, but otherwise comparatively smooth. There is a conspicuous detachable dermal specialization composed of tangentially arranged spicules and underlain by extensive subdermal cavities. The rare oscules are approximately 1 mm in diameter, very unevenly distributed, and apparently missing from some specimens, which is doubtless correlated with the fact that the sponge grows where the waves sweep back and forth, creating almost constant strong currents. The endosome bears some resemblance to bread in structure; it is much like many specimens of *Myrilla* and *Lissodendoryx*. There is some tendency to an isodictyal reticulation, which is obscured by the fact that each side of each mesh is composed of many instead of only one spicule. There are occasionally vague tracts, of several rows of spicules, reaching a diameter of approximately  $80\mu$ . The special dermal spicules are tylotes,  $4\mu$  by  $200\mu$  to  $5\mu$  by  $170\mu$ . The endosomal spicules are oxeas  $9\mu$  by  $210\mu$  to  $11\mu$  by  $215\mu$ . There are two sizes of arcuate isochelas for microscleres, but neither is typically arcuate. The larger type, approximately  $36\mu$  long, some-

times verges toward the palmate. The smaller one varies from  $16\mu$  to  $24\mu$  long and has three teeth at each end, which are so sharply pointed that this might almost be called unguiferate. There are abundant sigmas  $16\mu$  to  $24\mu$  in length of chord, and a few small oxoete spicules about  $2\mu$  by  $150\mu$ , which are only dubiously to be regarded as microscleres inasmuch as there exists a possibility that they may be immature stages of the principal megascleres.

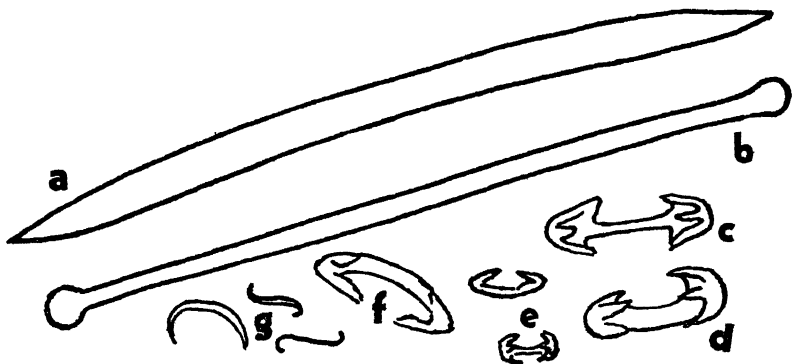


FIGURE 40.—*Zelekispongia zonea*, new genus and species: Spicules,  $\times 666$  (camera lucida). a, Endosomal oxea; b, ectosomal tylote; c, larger arcuate chela; d, abnormal form of same; e, side and front views of the smaller chela; f, side view of larger chela; g, three views of the sigmas.

Were the principal spicules monactinal instead of diactinal, this would be a *Lissodendoryx*. This one point of difference in the megascleres, however, is here interpreted as being exceedingly important. In sponges of the family Axinellidae, the transition from monactinal to diactinal spicules is made very readily, but this species is unlike those of the family Axinellidae; instead it should be regarded as of the family Phorbasidae.

#### Genus MYCALE Gray

##### MYCALE CECILIA, new species

FIGURE 41

*Holotype*.—U.S.N.M. no. 22207.

This species is exceedingly abundant on the rocks in the intertidal zone at Panama City but apparently is not found in any other location yet studied. At least during July and August 1933, it was easily recognized by its striking color scheme. In life it was basically green, abundantly provided with bright red specks, which are almost certainly embryos. They are about  $200\mu$  in diameter but show plainly to the unaided eye from a considerable distance. The consistency is soft, the surface even. The oscules are about 2 cm apart, and their maximum size cannot be readily given. They are discovered in sponges

exposed by the retreating tide only because of being at the center of stellate figures made by radiating subdermal canals; otherwise they would be overlooked. They are closed (perhaps by sphinctrate action) practically to zero diameter. In the endosome there are plumose ascending tracts ending at the surface in brushes of spicules. An approximate diameter of about  $100\mu$  might be assigned to them. There is only one type of megasclere, a tylostyle varying from about  $7\mu$  by  $300\mu$  to  $10\mu$  by  $300\mu$ . The microscleres include palmate anisochelas of two size ranges, the larger about  $22\mu$  to  $25\mu$ , the smaller about  $12\mu$  to  $15\mu$ . In face view the alae of these anisochelas seem to be extraordinarily narrow, only about one-fifth of the length of the spicule. As a result of this, in special spicule preparations, they usually lie on the side. Among them are fairly numerous sigmas  $30\mu$  in length of chord.

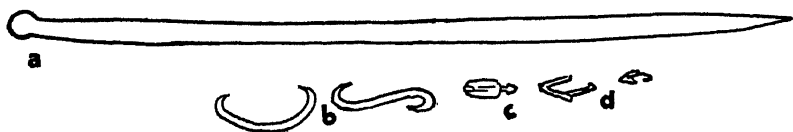


FIGURE 41.—*Mycale cecilia*, new species: Spicules,  $\times 444$  (camera lucida). a, Megasclere (tylostyle); b, two views of the sigmas; c, front view of the anisochela; d, side views of the chelas, showing extremes in size (there are intermediates).

The common West Indian *Mycale*, which is *M. angulosa* (Duchassaing and Michelotti, 1864, p. 89) has peculiarly narrow anisochelas, but its megascleres are exceedingly thin, only  $1\mu$  to  $4\mu$  in diameter, in contrast to  $7\mu$  to  $10\mu$  in the Panama sponge. Furthermore, *M. angulosa* is a sponge that quickly grows up coarse and erect with hollow cylindrical form predominating; it is cavernous and reddish brown. *Mycale imperfecta* Baer (1905, p. 20) from the east coast of Africa also has relatively narrow anisochelas, but these are of only one sort, and its megascleres are small, only about  $3\mu$  by  $200\mu$ , whereas its sigmas are large, frequently reaching nearly  $80\mu$  in chord length, and  $3\mu$  in thickness. Probably the closest relative to *cecilia* is *Mycale phyllophila* Hentschel (1911, p. 294). Its megascleres did not attain the thickness of those in *cecilia*. It is represented only by thin specimens growing on leaves. Were larger and maturer specimens available, further points of difference from the Panamanian sponge might be expected to appear.

#### Genus MICROCIONA Bowerbank

##### MICROCIONA ATROSANGUINEA Bowerbank

This species is represented in the collection by U.S.N.M. no. 22204. It occurs rather commonly on the rocks in the intertidal zone at Panama City as a bright-red, thin encrustation. Some of the smooth

dermal tylostyles are as small as  $1\mu$  by  $100\mu$ . Some of the endosomal tylostyles reach the maximum size of  $20\mu$  by  $670\mu$  and are minutely spined on their heads. The echinating acanthostyles are  $9\mu$  by  $90\mu$ , the toxas  $120\mu$  long, and the palmate isochelas  $12\mu$  to  $15\mu$ .

This, the genotype of *Microciona*, was described by Bowerbank (1862, p. 1109) from Great Britain, and his description of European specimens might do well for this from Central America. There is no significant point of difference, and the identification is made confidently.

#### Genus HALICHONDRIA Fleming

##### HALICHONDRIA PANICEA (Pallas)

This cosmopolitan sponge is represented in the collection by U.S.N.M. no. 22202 from the Pacific coast and by no. 22232 from the Caribbean. It was found encrusting rocks intertidally at both ends of the Panama Canal, on the beach at Fort Randolph on the Atlantic end, and on the Pacific side both on the mainland at Panama City and also on Taboga Island, 10 kilometers offshore. It is a thin crust, pale orange in life, friable in consistency, with a smooth surface, readily detachable special dermal membrane containing tangential spicules, which are, however, like those in the endosome, namely, sharply pointed oxeas of great variation in size. They range commonly from  $3\mu$  by  $180\mu$  to  $11\mu$  by  $270\mu$  and sometimes even to  $16\mu$  by  $930\mu$ .

It may conceivably be that there are different species of sponges in various parts of the world all of which by convergent evolution happen to share the same characteristics in common, and all identified as *Halichondria panicea*, but since it is impossible to separate them sharply on any characteristics that may be recorded on paper, it is customary to identify them all with the long-known European form first described as *Spongia panicea* by Pallas (1766, p. 388).

#### Genus PSEUDOSUBERITES Topsent

##### PSEUDOSUBERITES SULCATUS (Thiele)

This species, represented in the collection by U.S.N.M. no. 22214, was found growing on submerged wood near the piers in Balboa Harbor at the Pacific end of the Panama Canal. In life it was dull drab and semitransparent. The consistency is very soft; the surface is even, provided with a detachable special membrane over extensive subdermal cavities. This ectosome contains spicules tangentially placed. There are surface openings about  $140\mu$  in diameter, but these are not sharply differentiated into oscules and pores. In the endosome the spicules are arranged in considerable confusion. They are tylostyles ranging from  $4\mu$  by  $160\mu$  to  $6\mu$  by  $275\mu$ .

This species was described as *Suberites sulcatus* by Thiele (1905, p. 417) from the extreme southern end of South America. Burton (1930, p. 334) also records it from the Antarctic and correctly transfers it to the genus *Pseudosuberites*. There is no considerable point of difference between the Panamanian specimen and those from the sub-Antarctic and Antarctic.

Genus LAXOSUBERITES Topsent

LAXOSUBERITES ZETEKI, new species

FIGURE 42

*Holotype*.—U.S.N.M. no. 22212, from Balboa, Canal Zone, on the Pacific coast; no. 22227 is a specimen from the Caribbean.

This is in some respects the species most characteristic of the Panama coast, being found abundantly at each end of the canal. The specimens are frequently large and massive, with digitate or hemispherical projections, often as much as or more than 8 cm high. The masses are frequently as large as a person's head. The color in life is fundamentally an ochre-yellow; an exceedingly thin layer at the surface, however, may be tinged with greenish or reddish color, or, as in the case of specimens from the Atlantic end of the canal, be almost completely covered with a brownish red. These colors may be due to the presence of algal cells on the surface. The consistency is weakly spongy or mediocre. The surface, aside from the above-mentioned digitate projections, is somewhat tuberculate but otherwise smooth and even, not at all hispid. The oscules are exceedingly contractile. In living specimens they can sometimes be made out, attaining a diameter of as much as 1 mm, but in preserved specimens they are often entirely or nearly invisible. A few exceptional individuals were found in which the oscules remained open, over 2 mm in diameter, and surrounded by a collar more than 2 mm high. These specimens grew where the currents were not very strong. This variation in oscular condition is a result of environmental stimuli and lacks taxonomical significance. The spicules in the ectosome are densely packed, erect, with points out, but do not differ significantly in size or shape from those in the endosome. The interior is minutely cavernous to dense, with occasional meandering canals about 2 mm in diameter. The flagellate chambers are subspherical, about  $20\mu$  to  $25\mu$  in diameter. About them the megascleres are strewn in confusion. No microscleres could be found, all the spicules being tylostyles varying from about  $3\mu$  to  $20\mu$  by at least  $700\mu$  in length, and how much more must remain problematical, inasmuch as the largest spicules were always found broken.

This species shows practically no trace of tendency to radiate form. Many specimens of *Laxosuberites* show a radiate form to a very slight extent but always under circumstances that lead to the suspicion that the radiate tendency had been present but then suppressed by environmental conditions. *L. zeteki* grows frequently where other sponges assume the radiate form, and it is difficult to see how its placement could interfere with that result. In contrast to this, the other sponges

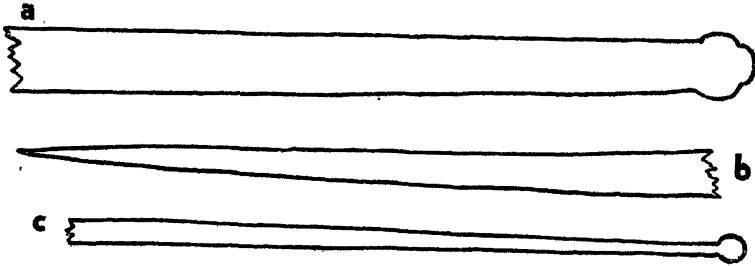


FIGURE 42.—*Laxosuberites zeteki*, new genus and species: Spicules,  $\times 533$  (camera lucida). a, Head or larger tylostyle; b, pointed end of same, middle portion not shown; c, head of smaller (immature) tylostyle.

in its immediate vicinity are practically never ramose. Its intertidal placement is not conducive to its habitus; instead the vigorous action of the waves would tend to compel most sponges to assume a merely encrusting form. In spite of this *zeteki* grows up massive with projections, occasionally almost ramose. For this reason there cannot be assigned any close relatives to it, and it is even questionable whether it should be left in the genus *Laxosuberites* or given another genus of its own. It is a very distinctively marked species.

The specific name is given in honor of Dr. James Zetek, of the United States Department of Agriculture, Balboa, Canal Zone.

#### Genus **TETHYA** Lamarck

##### **TETHYA DIPLODERMA** Schmidt

This subspherical sponge is represented in the collection by U.S.N.M. no. 22203. The color in life was yellow, the consistency cartilaginous. There is a cortex about  $800\mu$  thick grown into low tubercles about  $500\mu$  high and the same distance apart, apex to apex. It is hispid, with spicules projecting nearly a millimeter. The endosome is radiate, with ascending tracts of spicules about  $200\mu$  thick. The megascleres themselves are tylostyles, about  $11\mu$  by  $900\mu$  to  $14\mu$  by  $1,200\mu$ . The larger spherasters occur not at the immediate surface but in the deeper layer of the cortex, and rarely in the endosome, and are about  $67\mu$  in diameter. The smaller asters occur in the extreme outer cortex and abundantly throughout the

endosome. They are of two sorts, tylasters about  $10\mu$  in total diameter, and oxysspherasters only about  $7\mu$  in diameter.

This species was first described by Schmidt (1870, p. 52) from the West Indies and has since been recorded from the west coast of Mexico, the east coast of South America, both east and west coasts of Africa, the Indian Ocean, East Indies, and New Zealand. The Panamanian specimens are quite typical of the race as found around the world.

#### TABOGA, new genus

*Diagnosis*.—Family Tethyidae. The radiate, corticate structure resembles *Tethya*, but with very pronounced development of root structures. The strongyle-oxeote megascleres also resemble those of *Tethya*. The microscleres include spherasters somewhat like those of *Tethya*, but in addition there are typically three other distinct categories of asters, one of which is peculiar for sharply branched terminations to its rays.

*Genotype*.—*Taboga taboga*, new species.

#### TABOGA TABOGA, new species

#### FIGURE 43

*Holotype*.—U.S.N.M. no. 22216.

This species is moderately abundant intertidally on Taboga Island at the Pacific end of the entrance to the Panama Canal; it was not found elsewhere. The shape is subspherical, up to slightly over 2 cm in diameter, but most of the specimens are only about 1 cm in diameter. Each is attached to the substratum by ribbon-shaped roots, only 0.1 to 0.2 mm thick but usually 2 mm wide. There are ordinarily 5 to 15 such roots extending from each sponge and reaching out in some cases as much as 1 cm or more, anchoring the mass very firmly so that it may be held in place in spite of vigorous wave action. In life the surface is covered with a dull red layer 1 mm deep. This consists of a spicule plush of megascleres standing erect, rarely embedded in the white surface below them, and interspersed with rather loosely placed reddish cells that may or may not be proper to the sponge. The regularity with which they occur and the uniformity of their color suggest, however, that they are proper.

Below this red layer is a white layer of equal thickness. Its structure is corticate to cartilaginous. It represents the most extreme development of contractile tissue in any sponge known to me. Below the red-and-white layers the endosome is ochre-yellow and permeated by transparent fascicular columns packed with spicules radiating from the central point of the sponge to the surface. Above them the surface is thrown into tuberculous protrusions not quite 1 mm in

diameter. The oscules and pores are each minute and not readily made out. The root-like structures mentioned above are rendered shaggy, being densely packed with spicules, and contain practically no cavernous structures. The megascleres are spindle-shaped strongyles, or strongyloxeas, commonly  $13\mu$  by  $600\mu$ , occasionally slightly inequidended. Some, in fact, are almost styles. Spherasters with very sharply pointed rays, total diameter about  $65\mu$ , occur abundantly in the whitish ectosomal layer and to a certain extent also in the endosome. Both in the cortex and in the endosome occur also a few asters with conspicuously hastate pointed ends to the rays, total diameter  $60\mu$ , and comparatively abundant others, similar but

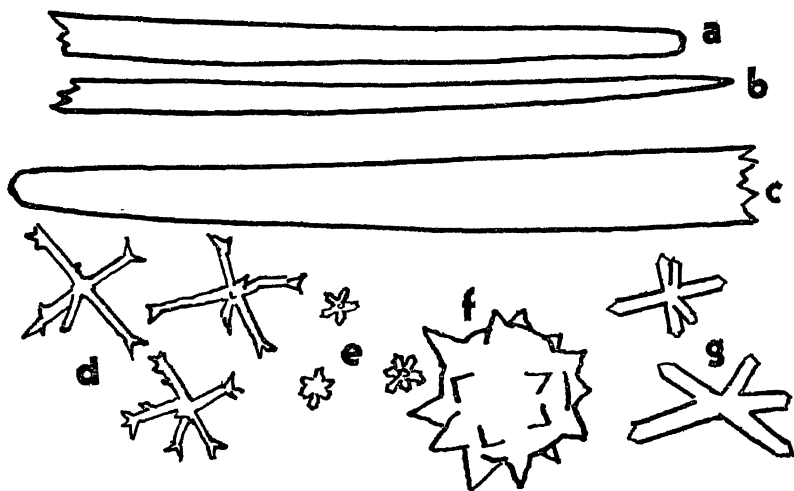


FIGURE 43.—*Taboga taboga*, new genus and species: Spicules,  $\times 666$  (camera lucida). a, Common termination (of end toward ectosome) of the megasclere; b, as above, but a less common sort; c, termination (away from ectosome) of the megasclere; d, three views of the most distinctive sort of aster; e, three views of the most common sort of aster; f, ectosomal spheraster; g, two views of the (uncommon) larger hastate rayed asters.

with very short rays, diameter  $12\mu$ . In the endosome occur only long-rayed euasters (perhaps provided with a minute centrum), total diameter  $36\mu$  to  $60\mu$ , the rays occasionally dichotomously or trichotomously branched at the end, and provided with a very few spines laterally placed on them.

One of the most remarkable characteristics of this unusual sponge is the strength of its muscular(?) tissue. When a living specimen is cut into deeply the cortex contracts so strongly that the endosome is forced to protrude from the wound. The collector with his fingers was unable to restrain this contraction and gives it as his opinion that the force was greater than that of the muscles that bend the fingers of a person with ordinary strength.



Genus **PLACOSPONGIA** Gray**PLACOSPONGIA INTERMEDIA** Sollas

This species is represented in the collection by U.S.N.M. no. 22201, from the Pacific side, and no. 22233, from the Atlantic side of the Canal Zone. It is moderately common at each end of the canal, forming encrustations about 1 mm thick on coral or rock. The color in life is orange-ochre, changing to brown or drab in places where it seems to have been adversely affected by the environment. The consistency is friable, hard. The surface is given over to conspicuous polygonal plates separated by cracks only about  $100\mu$  wide. These plates are about  $150\mu$  to  $350\mu$  thick, and seem to be imperforate. The inhalent and exhalent apertures are presumably in the cracks between them. The endosomal structures are chiefly in confusion, but a few vague tracts about  $100\mu$  in diameter may be made out. The megascleres are exclusively tylostyles, of which, however, the heads are sometimes so small as to be barely larger than the shaft. These vary in size from about  $6\mu$  by  $250\mu$  to  $8\mu$  by  $400\mu$ . The dermal cortex is densely packed with sterrasters  $20\mu$  by  $35\mu$  to  $35\mu$  by  $50\mu$ . Among the other microscleres are small spheres about  $8\mu$  in diameter, covered by minute spines; these are young forms of the sterrasters, as shown by the existence of forms intermediate between them. These occur chiefly in the endosome, as do the abundant spirasters  $1\mu$  by  $4\mu$  to  $2\mu$  by  $8\mu$ . There are also short spirasters or plesiasters with very long spines with a tylote to strongylote modification at the end of each. These range from about  $14\mu$  by  $18\mu$  to  $15\mu$  by  $20\mu$ .

*Placospongia intermedia* was described by Sollas (1888, p. 272) from Punta Arenas, Central America. There is a large port by this name on the Pacific coast of Costa Rica, presumably the locality referred to. It appears to be a form characteristic of this portion of the world. There is no significant difference between the specimen found on the Pacific side of Panama and those found at the Atlantic side.

Genus **GEODIA** Lamarck**GEODIA GIBBEROSA** Lamarck

This massive species is represented in the collection by U.S.N.M. no. 22217, from the Pacific side, and no. 22231, from the Atlantic side of Panama. It is gray-white, cartilaginous in consistency, and has a surface hispid in places only. The pores are very conspicuous, about 1 mm apart and 0.3 mm in diameter. The oscules are equally conspicuous, circular, in depressed areas, and are about 1 to 3 mm in diameter. There is a cortex 0.5 to 1 mm thick, which is densely packed with spherasters about  $60\mu$  by  $75\mu$ . The endosome is strongly radiate with principally large oxeas, about  $27\mu$  by  $800\mu$  or larger, and plagio-

triaenes with rhabds about  $30\mu$  by  $3,000\mu$ . Among the microscleres, in addition to the sterrasters, there are euasters  $10\mu$  to  $15\mu$  in diameter and very small spherasters, mostly centrum, the entire spicule only about  $3\mu$  in diameter.

The last-mentioned type of microscelere is one of the most characteristic features of *Geodia gibberosa*, which was described by Lamarck (1815, p. 334) from the West Indian region, of which it is very characteristic.

#### Genus OSCARELLA Vosmaer

##### OSCARELLA LOBULARIS (Schmidt)

This species is represented in the collection by U.S.N.M. no. 22206. It was found growing (as usual) as a thin encrustation on rocks in the intertidal zone at Panama City on the Pacific side of the isthmus. In life it is transparent and drab, consistency mediocre, surface smooth and even. The oscules and pores were not optically evident. The flagellate chambers are spherical,  $25\mu$  in diameter.

This aspiculous, askeletal, interesting species is probably cosmopolitan, although nowhere abundant. It was first described as *Halisarca lobularis* by Schmidt (1862, p. 80). It is difficult to find any basis for separating those Oscarellas found in other parts of the world from the original European species with which they may indeed be genuinely conspecific. The Panama specimens are quite typical.

### DESCRIPTION OF ATLANTIC COAST SPECIES

The six species found also at the Pacific end of the Panama Canal—*Haliclona coerulescens*, *Adocia cinerea*, *Halichondria panicea*, *Laxosuberites zeteki*, *Placospongia intermedia*, and *Geodia gibberosa*—are not repeated here.

#### Genus SPONGIA Linnaeus

##### SPONGIA BARBARA Duchassaing and Michelotti

This species is represented in the collection by U.S.N.M. no. 22230. It is a subspherical mass, black exteriorly and dull ochre in the endosome. The consistency is exceedingly spongy. The surface conules are not quite 1 mm high and about 1 mm apart. The oscules, about 3 mm in diameter, are raised, with slight collars about them. The flagellate chambers are spherical, about  $20\mu$  in diameter. The common fiber that makes up the customary dense reticulation is  $30\mu$  in diameter. The general structure is that of the common sponge of commerce, known as the "yellow."

Hyatt (1877, p. 515) records what he calls *Spongia lignea* from Pearl Island, Panama Bay. This is inadequately described because of the poor condition of Hyatt's material.

While in Panama I met an elderly Greek gentleman named Kefalos who claimed to have been a sponge fisherman in his younger days and to have collected and sold commercial sponges from the vicinity of Panama on both coasts, though more commonly from the Atlantic side. On the Pacific side I met a professional shark fisherman who claimed to have seen a few commercial sponges, although none could be found at that time. The evidence would appear to show that there was little economic importance to be attached to sponge fisheries from this immediate neighborhood, as commercial sponges do not exist in great enough abundance.

This species was collected on the coast at Fort Randolph on the Atlantic Coast of Panama near the north end of the Canal.

#### Genus *TRYPESPONGIA* de Laubenfels

##### *TRYPESPONGIA COLUMBIA* de Laubenfels

This species is represented in the collection by U.S.N.M. no. 22243. It was collected on the coast at the Atlantic side of the Canal Zone at Fort Randolph. In shape it is an amorphous mass. It was drab in life. Its consistency is exceedingly spongy. The surface conules are less than 1 mm high and are 1 mm apart, more or less. The abundant oscules are about 1 mm in diameter and are scattered in irregular groups. In the groups they are only 2 or 3 mm apart, but the groups themselves are 2 or 3 cm apart. The interior is strongly reticulate, with ascending fiber reaching  $65\mu$  in diameter, containing some foreign material in addition to the spongin. The more abundant secondary fibers are about  $25\mu$  in diameter and contain no foreign material. There is some detritus, especially broken foreign spicules, scattered loosely in the flesh. The histological structure of this species is very remarkable. The protoplasmic portions are arranged in thin sheets, only about  $25\mu$  to  $35\mu$  thick, which are arranged haphazard without any very definite pattern but crowded fairly close together. Those structures, which correspond obviously to flagellate chambers in ordinary sponges, are little more than apertures or oval holes through these sheets,  $30\mu$  to  $40\mu$  in diameter.

It is not known whether the species is important commercially. It was described from the West Indies by deLaubenfels (1936, p. 13).

#### Genus *HIRCINIA* Nardo

##### *HIRCINIA CAMPANA* (Lamarck)

This species is represented in the collection by U.S.N.M. no. 22248. It grows abundantly in shallow water near Fort Sherman at the Atlantic end of the Panama Canal. The typical shape is a vase-like form, frequently 20 cm high. The color in life is reddish brown, the consistency tough and spongy. It is coarsely conulose, with the conules 1 mm high and about 3 mm apart. The abundant oscules

are located chiefly or entirely on the interior of the vase. The principal spongin tracts are fascicular and coarse, and among them are many filaments of a substance resembling, but perhaps not the same as, spongin, about  $4\mu$  thick, with swollen heads  $5\mu$  or  $6\mu$  thick at each end, the total length being frequently more than 1 mm.

This species was described as *Spongia campana* by Lamarck (1814, p. 385) from the West Indies, where it is one of the most abundant and typical sponges.

#### HIRCINIA VARIABILIS (Schmidt)

This species is represented in the collection by U.S.N.M. no. 22249. It grows abundantly in shallow water near Fort Sherman at the Atlantic end of the Panama Canal. The shape is amorphous to encrusting, with digitate processes occasionally rising from the main mass. The color in life is greenish brown, and the consistency is tough and spongy. The conules are small, only about 0.5 mm high and 1 to 2 mm apart. The oscules are exceedingly conspicuous, not only because they have collars raised about them, but because the tissues immediately within them are very dark. The fascicular tracts and filaments are very much like those in the preceding species.

This may not be exactly the same species as that first described as *Filifera variabilis* by Schmidt (1862, p. 34), a Mediterranean form, but it does not seem appropriate to establish a new name for it at the present time. The form occurring at Panama is exceedingly abundant throughout the entire West Indian region.

#### Genus HALICLONA Grant

##### HALICLONA ERINA, new species

*Holotype*.—U.S.N.M. no. 22245.

This species was found growing intertidally on the Atlantic coast of Panama at Fort Randolph. The shape is amorphous to encrusting. The color in life was a brilliant green. The consistency is mediocre, with a notable lack of any special dermal skeleton, a lack entirely typical of the genus *Haliclona*. The endosome in places shows an isodictyal reticulation, and elsewhere there are vague ascending tracts about six spicule rows thick, or even as much as  $50\mu$  thick. The flagellate chambers are spherical, about  $30\mu$  in diameter. The only type of spicule present is a sharp-pointed oxea, but the variation in size is greater than is customary in the genus *Haliclona*, somewhat like that of *Halichondria*. The spicules range from as small as  $3\mu$  by  $120\mu$  to as large as  $10\mu$  by  $200\mu$ . Because of the surface structure, however, the identification is made with *Haliclona*, within which genus, in addition to various minute differences, the bright green

color is distinctive. It must be admitted that this may be a remarkable modification of some previously described *Haliclona*, due perhaps to unusual environmental conditions, but it is impossible to say which *Haliclona* has been so modified. It is not certain that this is the real situation, and it seems preferable to give a definite name by which the species may be referred to rather than merely to call it *Haliclona* "species indeterminate."

*HALICLONA DORIA*, new species

*Holotype*.—U.S.N.M. no. 22228.

One very large specimen was found growing in shallow water on the shores near Fort Randolph. It was a ramose bush, in life reaching a height of nearly 1 meter, with perhaps as many as 100 branches. Each of the branches is circular in cross section and a little over 1 cm in diameter. The color in life was mahogany-brown. The consistency in life was slightly flexible, very stiff. It is rather fragile as preserved in alcohol. To the naked eye the surface is even, although microscopically rough. The abundant pores are about  $100\mu$  to  $200\mu$  in diameter. The oscules are 2 to 3 mm in diameter and may or may not be provided with an oscular collar about them. They are very irregularly distributed, often in rows along one side only of a cylindrical branch. In the row they are only about 1 cm apart. The internal structures are very compact, the fibers crossing each other in reticulation almost at right angles, all of them, both ascending and transverse, being approximately the same size, varying between  $20\mu$  and  $50\mu$ . The ground substance about the fibers is subisodictyal. Only one type of spicule is present, an oxea  $9\mu$  by  $170\mu$ .

At and near the point of collection there were practically no other sponges even approaching the ramose form. It was a beach where the waves regularly broke with considerable force, and there was clear-cut evidence that the environment was not very favorable to this habitus. It is true that there was a depression in the immediate vicinity of this specimen, but not enough to have prevented all buffeting by waves. The conclusion, therefore, is that this species shows an unusually strong tendency toward the ramose form. This, together with the somewhat unusual color, is rather distinctive within *Haliclona*, large as that genus is. Perhaps the species nearest to the one under consideration is that described as *Thalysias subtriangularis* Duchassaing and Michelotti (1864, p. 85). Compared to that, *doria* has larger spicules, a different color, and the branches terminate in sharp points instead of blunt clublike shapes. This is about all that can be said definitely, but to the person who handles the two species in life, as I did, the general impressions and feeling are so strikingly different that there is no suggestion that the two are the same.

Genus **STRONGYLOPHORA** Dendy**STRONGYLOPHORA SANTA**, new species

*Holotype*.—U.S.N.M. no. 22244.

This species is found growing intertidally on the shore near Fort Randolph. The shape is amorphous, the color in life greenish black, and the consistency between friable and stony. There is a distinct special dermal structure present, overlying extensive subdermal cavities. The surface is comparatively smooth and even. There are very few oscules, about 1 mm in diameter, not provided with collars about them. The internal structure is subisodictyal, somewhat resembling "crumb-of-bread." There is an astonishingly large variation in the size of the flagellate chambers. They are subspherical and range from only  $18\mu$  up to as much as  $36\mu$  in diameter. Throughout the basal reticulation there is another one of fibers containing much spongin and only a few rows of spicules, say three or four. This fiber is about  $40\mu$  in diameter. The spicules are of two sorts. The most abundant kind is a strongyle usually  $17\mu$  by  $250\mu$ , but varying from at least as small as  $12\mu$  by  $240\mu$  to as large as  $18\mu$  by  $270\mu$ . The second sort of spicule is an oxea  $5\mu$  by  $215\mu$  in ordinary size.

The genotype of the genus *Strongylophora* is *durissima*, described by Dendy (1905, p. 141) from Ceylon. It is much like the Panamanian sponge here described, except for paler color, crumpled external shape, and much smaller microxea, which were very thin and only  $28\mu$  long. The same general comparison may be made to all the other species customarily referred to the genus *Strongylophora*; i. e., their microscleres are a great deal smaller than those in *santa*. They are all probably rather closely related to one another.

Genus **TEDANIA** Gray**TEDANIA IGNIS** (Duchassaing and Michelotti)

This species is represented in the collection by U.S.N.M. no. 22247. It grows abundantly in shallow water in the vicinity of Fort Sherman, the masses being frequently about the size of a man's fist. The color in life is a brilliant red. The consistency is mediocre to spongy. The surface is even, over low, wide tuberculate structures. There is a definite special dermal membrane overlying extensive subdermal cavities. The oscules are about 5 mm in diameter and frequently have oscular collars about them as much as 5 mm high or even more. The general structure is somewhat cavernous. The special dermal spicules are tylotes  $4\mu$  by  $230\mu$ . The endosomal spicules are styles  $9\mu$  by  $300\mu$ , and the microscleres are the so-called onychaetes, roughened rhapides, about  $2\mu$  by  $110\mu$ .

This species was first described as *Thalysias ignis* by Duchassaing and Michelotti (1864, p. 83). It is one of the most abundant and

characteristic of all West Indian sponges. As to whether it is conspecific with other species in the genus *Tedania* found in other parts of the world there is considerable room for argument.

#### FISHERISPONGIA, new genus

*Diagnosis*.—Family Ophlitaspongiidae. A genus with two distinct categories of megascleres, a dermal tylostyle and an endosomal plain style, associated with toxas and palmate isochelas. Diagnostic reference may or may not be added as to the quantity of sand present. The dense, almost radiate, structure, however, is not typical of the family Ophlitaspongiidae but verges strongly toward that of the order Haplosclerina. The genus that should be most closely compared here is *Camptisocale* Topsent (1927, p. 7) described from the Azores. It has significantly similar structure and has the polytylote dermal spicules over styles as principal megascleres. Its only microscleres, however, are odd-shaped palmate anisochelas. A second similar genus is

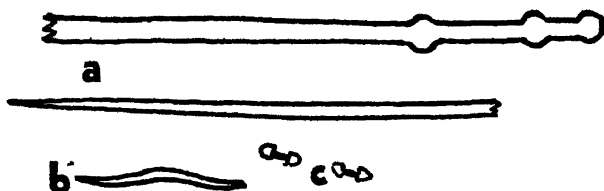


FIGURE 44.—*Fisherispongia ferrea*, new genus and species: Spicules,  $\times 666$  (camera lucida). a, Terminations of the megasclere sort (polytylote style) mid portion not shown; b, toxas; c, two views of the isochelas.

*Phelloderma*, described by Ridley and Dendy (1887, p. 85) from the South Atlantic. This also has the polytylote spicules together with plain styles, and palmate isochelas, but these are of remarkable shape, being almost the sort known as a placochela.

*Genotype*.—*Fisherispongia ferrea*, new species.

The generic name is given in respect to the eminent zoologist, Prof. W. K. Fisher, of Stanford University, California.

#### FISHERISPONGIA FERREA, new species

FIGURE 44

*Holotype*.—U.S.N.M. no. 22239.

This species is found growing intertidally at Fort Randolph. The shape is amorphous, and the color in life is bright red. The consistency is obscured by the fact that it is full of foreign materials and sand. The surface is between tuberculate and even, and the pores and oscules are not readily made out. There is a conspicuous layer of spicules with their heads on the substratum, standing erect with

respect to it, and from them semiplumose bushes of spicular tracts arise toward the surface, where they form tufts. The spicules at the surface are considerably smaller than those farther down and are polytylote tylostyles; i. e., they not only have the tylote swelling at the blunt end, but several similar swellings interposed here and there along the length of the spicule. Their size is about  $2\mu$  by  $250\mu$ . The endosomal spicules are smooth styles about  $9\mu$  by  $500\mu$  or  $600\mu$ . There are two sorts of microscleres, each very abundant. One sort is a toxa about  $35\mu$  long, and the other a palmate isochela only  $10\mu$  long.

### Genus CLIONA Grant

#### CLIONA CARIBBOEA Carter

This species is represented in the collection by U.S.N.M. no. 22241. It occurs boring into calcareous material (frequently dead coral) on the beach at Fort Randolph and perhaps at other places in the Canal Zone. Its color in life is yellow, and the consistency is cartilaginous. The external structures are papillate bits of flesh that protrude here and there from the calcareous material and that reach a size of slightly over 1 mm in diameter and height. The apertures are slightly under 1 mm in diameter when fully opened, and they are found apically situated on the papilles. Only one type of spicule was found in the Panamanian specimens. This is a tylostyle about  $14\mu$  by  $350\mu$ .

This species was described by Carter (1882, p. 346) from the West Indies, of which it may be said to be very characteristic, unless it should be decided that it is conspecific with the cosmopolitan species *Cliona celata* Grant, to which it bears considerable resemblance.

### Genus SPIRASTRELLA Schmidt

#### SPIRASTRELLA CUNCTATRIX Schmidt

The specimen thus tentatively identified is represented in this collection by U.S.N.M. no. 22226. It is a thin crust collected intertidally at Fort Randolph. It was bright orange in life and cartilaginous in consistency. The surface is even, and the spicules consist exclusively of tylostyles varying in size from  $7\mu$  by  $250\mu$  to  $11\mu$  by  $415\mu$ , associated with spirasters. These are at the most only  $15\mu$  by  $20\mu$ , and many are much smaller than this.

*S. cunctatrix* was described by Schmidt (1868, p. 17). The present specimen differs in many minor ways from the Mediterranean kind, but it is not now deemed advisable on the basis of the quantity of material present and in view of the slight differences, to establish for it a new species.



Genus **TETHYA** Lamarck**TETHYA AURANTIA** (Pallas)

This species is represented in the collection by U.S.N.M. no. 22234. It occurs intertidally at Fort Randolph. It is spherical in shape and was bright orange-yellow in life. The consistency is cartilaginous, and the surface is coarsely tuberculate, with rounded tubercles crowded closely together, each about 2 mm in diameter and height. The megascleres are strongyloxeas about  $25\mu$  by  $2500\mu$ . The microscleres include large spherasters about  $55\mu$  in diameter and small spherasters only about  $9\mu$  in diameter.

This cosmopolitan species was described by Pallas (1766, p. 357) as *Alcyonium aurantium*. The Panamanian specimens do not differ in any significant respect from the numerous ones found in all parts of the world.

Genus **CINACHYRA** Sollas**CINACHYRA APION** Uliczka

This species is represented in the collection by U.S.N.M. no. 22229. The one specimen was collected intertidally at Fort Randolph. It was yellow in life. Its consistency is between cartilaginous and mediocre. It is exceedingly hispid with a spicule plush 2 mm high or more over the entire surface. The abundant openings, representing probably both inhalent and exhalent structures, are cavities 1 to 3 mm in diameter, rounded at the bottom of the concavity, and so abundant that in many places they are only 3 mm apart. The internal structure is strongly radiate, including numerous oxeas, about  $30\mu$  by 3 mm long, and protriaenes and anatriaenes having rhabds of about the same size range as the oxeas. The clads of these spicules diverge very widely, almost at right angles to the main shaft, so that they do not differ greatly from orthotriaenes. The microscleres are small sigmoid spicules  $10\mu$  in length of chord.

This species was described by Uliczka (1929, p. 43) from the West Indies, to which locality it appears to be restricted.

**PLAKOOSA**, new genus

*Diagnosis*.—Family Halinidae. A genus having as spicules two size ranges of very small, much modified tetraxon spicules, the smaller of which resemble asters.

Relationship is indicated to *Plakortis* Schulze, which does not have the latter type of spicule, to *Halina* Bowerbank in which the second type is an obvious streptaster, and closest of all to a common West Indian sponge, *Roosa zyggompha* deLaubenfels (1934, p. 2), which has somewhat similar megascleres, but not the microscleres.

## PLAKOOSA ELISA, new species

## FIGURE 45

*Holotype*.—U.S.N.M. no. 22237.

The one specimen of this interesting species was collected intertidally at Fort Randolph. It is an encrustation considerably less than 1 mm thick and about 2 by 4 cm in lateral area. The color in life was blue; the consistency is mediocre. The surface is minutely punctiform. The depressions here referred to are perhaps to be interpreted as the location of pores. The entire surface is thickly set with apertures about  $200\mu$  in diameter, one or more to the square millimeter; which of these are exhalent and which inhalent cannot readily be made out. The internal structure is densely fleshy, except for the flagellate chambers, which are spherical, approximately  $55\mu$  in diameter. About them the spicules are densely crowded. Those that are possibly to be interpreted as megascleres are not much larger than microscleres. They are commonly siliceous triaxons, with each ray approximately  $2\mu$  by  $25\mu$ . Some of them



FIGURE 45.—*Plakoosa elisa*, new genus and species: Spicules,  $\times 666$  (camera lucida). Only relatively abundant sorts are shown.

may be described as sagittal with a very short rhabd or as a bent oxea with a spine at the middle. Others have two spines at the middle, as if they were reduced tetraxons. Still others are like oxeas, with a bend in the middle that doubtless represents the place where a hypothetical third or even fourth ray may have been placed. All the megascleres may plausibly be interpreted as reduced tetraxons. The microscleres bear a faint resemblance to asters, but although they show much variation in shape, the following type is common: There is an oxeote central shaft about  $12\mu$  long, from the middle of which protrude one or more branches about  $4\mu$  or  $5\mu$  long, each of which in turn has one or two branches only  $1\mu$  or  $2\mu$  long. Each ray is  $1\mu$  or less in diameter. These might be further named, by using the prefixes that are both applicable and customary, "micromesoorthotrichotriaenes."

**Genus CHONDRILLA Schmidt****CHONDRILLA NUCULA Schmidt**

This species is represented in the collection by U.S.N.M. no. 22235. It is found growing on the coast near Fort Randolph. The shape is amorphous to rounded, the color in life sepia-brown, and the consistency cartilaginous. The surface is even, and resembles rubber. The internal structures are densely colloidal, with fairly abundant spherical flagellate chambers about  $20\mu$  in diameter. The only type of spicule present is a spheraster about  $30\mu$  in diameter.

This species was described by Schmidt (1862, p. 39). It is found not only in the Mediterranean and in Australia, but abundantly in the West Indies.

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# PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM



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## NEW SPECIES OF POLYCHAETOUS ANNELIDS OF THE FAMILY NEREIDAE FROM CALIFORNIA

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ANNELIDS of the family Nereidae from many sources have been used in this study. Collections that were made by many persons over many years and that have accumulated in the department of zoology of the University of California at Berkeley were especially valuable. My own collecting was very extensive for Moss Beach, San Mateo County, and less complete for other parts of California, including points between Mendocino County and Los Angeles County. In addition, several smaller recent collections furnished a few interesting species. Such are the collection made at Dillon Beach, Marin County, by Prof. O. L. Williams, of the College of the Pacific at Stockton; one made at Pacific Grove, Monterey County, by Dr. R. M. Eakin; and one made off southwestern Oregon by Prof. C. R. Monk, of Willamette University. Holotypes are deposited in the United States National Museum; paratypes of all except *Nereis* (*Eunereis*) *longipes*, known only from the unique holotype, are in the California Academy of Sciences and the University of California collections.

The species of *Nereis* (sensu stricto) found in California are characterized by their posterior parapodia being provided with falcigerous homogomph notosetae (fig. 46, *d*). They can be arranged in series based on the relative proportions of the dorsal lobes of the posterior parapodia. Starting with *N. pelagica* Linnaeus, which seems most generalized, one such series would include those in which

the dorsal lobe assumes the shape of an acute triangle—*N. procera* Ehlers, *N. neonigripes*, new species, *N. natans*, new species, and *N. eakini*, new species. Another series, in which there is a tendency for the dorsal lobe to become quadrangular, includes *N. zonata* Malmgren, *N. pseudoneanthes*, new species, *N. mediator* Chamberlin, *N. eucapitis*, new species, and *N. vexillosa* Grube. Two species not fitting into these series are *N. limnicola* Johnson, in which there is a marked tendency toward reduction of all the lobes, and *N. latescens* Chamberlin, in which both the dorsal lobes and postsetal lips are produced laterally. *Nereis monterea* Chamberlin is a *Perinereis*.

#### Genus NEREIS Linnaeus

##### NEREIS (NEREIS) EUCAPITIS, new species

##### FIGURE 46

*Measurements*.—Length, 15–30 mm; width with parapodia, 4.5 mm in anterior third of body; number of segments, 65–75.

*Description*.—Prostomium broad (fig. 46, *a*), set off from palpi by faint emargination, producing a flat appearance of dorsal surface of “head”; provided with four black eyes set at lateral margins of widened posterior portion of prostomium.

Antennae (fig. 46, *a*) about as long as distance separating their basoectal margins; diverging distally.

Palpi elongated, cylindrical; basal portion of palpodes thickened ventrally so that the two almost touch medially; distal halves of almost uniform diameter (fig. 46, *a*) extending distally beyond tips of antennae; palpostyles slightly narrower than palpodes, almost spherical.

Peristomium at least  $2\frac{1}{2}$  times as long as segment 2 and somewhat narrower (fig. 46, *a*), constricted in middle region; produced ventrally to form an almost smooth, flat lower lip; peristomial cirri relatively short, the longest reaching to palpostyle; cirrophores low, smooth (fig. 46, *a*).

Paragnaths light to dark brown; maxillary ring with smaller teeth, basal ring with mostly larger teeth and a few smaller teeth; I with a single small flat cone; II with a small oblique crescent of about 10 rounded flat cones; III with a patch of three irregular rows of low cones; IV with four transverse rows of many small points; V without teeth; VI with four large high cones; VII–VIII with a continuous band of large tall cones, as in VI, and a patch of smaller cones on the maxillary side of VII.

Jaws strongly curved inward at middle; dark brown distally; with six blunt rounded teeth and a plain distal portion as long as two teeth.

Parapodia of anterior region low and rounded, their dorsal cirri exceeding in length the dorsal lobes, their ventral cirri not greatly longer than the ventral lobes (fig. 46, *b*); in median parapodia the setigerous lobes and cirri become relatively longer; from the twenty-first segment falcigerous homogomph setae appear singly in notopodia and continue so to posterior end; dorsal lobes in posterior third of body broader, carrying dorsal cirri more distally; posterior parapodia with a conspicuously widened area of the middle portion of the dorsal lobes (fig. 46, *c*), with dorsal cirri attached at end of dorsal lobes.

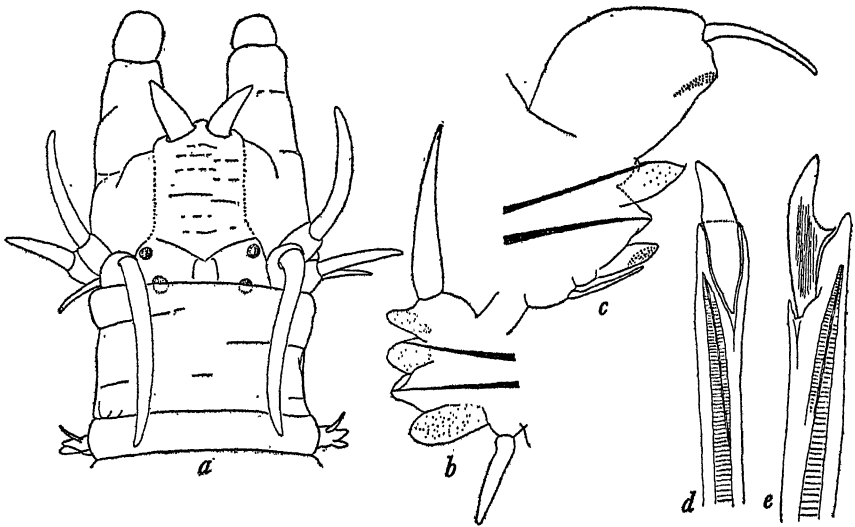


FIGURE 46.—*Nereis (Nereis) eucapitis*, new species: *a*, Anterior end in dorsal view,  $\times 18$ ; *b*, twenty-fifth parapodium in anterior view,  $\times 40$ ; *c*, posterior parapodium,  $\times 26$ ; *d*, falcigerous homogomph notoseta,  $\times 333$ ; *e*, falcigerous heterogomph neuroseta,  $\times 333$ .

Setae all composite, of the usual four types; falcigerous notosetae and neurosetae as in figure 46, *d*, *e*.

Anal cirri two, as long as a posterior segment.

*Holotype*.—U.S.N.M. no. 20198.

*Distribution*.—Duxbury Reef, north of San Francisco, Calif., south to San Pedro, Calif. Common.

*Remarks*.—In general appearance of "head" and parapodia this species resembles *N. cockburnensis* Augener, 1913, from Southwest Australia. It differs from that species in its dentition, particularly in areas V, VII, and VIII. Among the *Nereis* (sensu stricto) from California, it lies between *N. vevillosa* and *N. mediator*. The proportions of the prostomium and peristomium and the outwardly curved dorsal edge of the dorsal lobe in posterior parapodia readily separate *N. eucapitis* from other species of *Nereis*.



## NEREIS (NEREIS) PSEUDONEANTHES, new species

FIGURE 47

*Description*.—Prostomium with a broad flat dorsal surface, much as in *N. eucapitis* but with palpi conical and much less elongated, tapering gradually distally.

Parapodia (fig. 47, *b*, *c*) strikingly like those of *N. vexillosa* Grube; setae also much as in *vexillosa*; posterior notosetae as in figure 47, *a*.

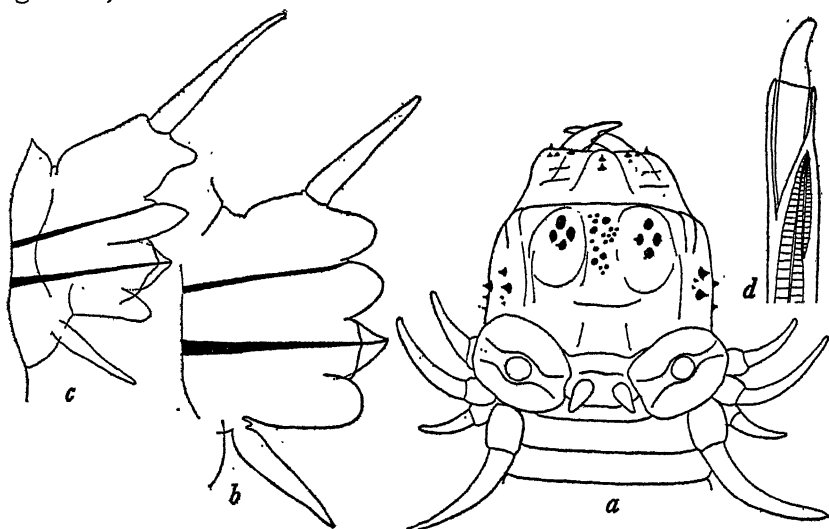


FIGURE 47.—*Nereis (Nereis) pseudoneanthes*, new species: *a*, Anterior end in dorsal view, with proboscis extruded and with prostomium pushed back and seen from anterior end,  $\times 11$ ; *b*, tenth parapodium in posterior view,  $\times 39$ ; *c*, posterior parapodium in posterior view,  $\times 39$ ; *d*, a falcigerous homogomph notoseta,  $\times 333$ .

Paragnaths (fig. 47, *a*) : Area I with two small cones in tandem; II with an elongated patch of eight low pale-brown cones; III with three transverse rows of small teeth in an oval patch, teeth low, almost platelike; IV with about three rows of platelike teeth in a wide-open crescent (this area with the greatest number of teeth on the maxillary ring); V with a patch of 15 to 20 irregularly spaced, low, chitinous, platelike teeth of various sizes, almost filling space between V–VI (fig. 47, *a*); VI with four high, pointed, brown cones disposed in a diamond; VII–VIII with a single row of tiny, pointed, brown cones, a continuous band of four irregular rows of teeth as large as those of VI, and an oval patch of about 30 tiny teeth on the maxillary side of VII.

Jaws horny brown, with two or three denticulations and one to three weak crenulations.

*Holotype*.—U.S.N.M. no. 20199.

*Localities*.—San Pedro and La Jolla, Calif.

*Remarks.*—*Nereis pseudoneanthes* differs from *N. vexillosa* Grube and *N. mediator* Chamberlin in its dentition. Each of the nine specimens in the collection has area V of the 'proboscis beset with numerous chitinous platelets.

NEREIS (NEREIS) NEONIGRIPES, new species

FIGURE 48

*Description.*—Prostomium (fig. 48, *a*) with an anterior portion about as long as wide; basal portion, in region of eyes, almost twice as wide; its length subequal to its width; prostomial antennae longer than width of anterior end of prostomium, their bases separated by a distance equal to their diameter (fig. 48, *a*).

Palpi stout, thickened dorsoventrally; extending distally to beyond tips of antennae; palpostyles spherical (fig. 48, *a*).

Paragnaths dark brown; area I with two teeth in tandem; II with about 10 blunt cones, smaller than those of III; III with 10 to 12 blunt cones forming an oval transverse patch; IV with a crescent of many, mostly larger, teeth, with a few smaller cones at the periphery of the patch; V with none; VI with four (rarely three) high cones; VI–VIII with a continuous band of three irregular rows of many teeth and a row of larger cones on the maxillary side.

Jaws deep horny brown, thickened distally, with four shallow oblique teeth and one crenulation more proximad.

Parapodia (fig. 48, *b*, *c*) with lobes thickened, bluntly rounded, the first 15 giving impression of terminating in dark spheres, on account of dark pigmentation; all lobes equal or subequal as far as mid region of body, after which dorsal lobes progressively though gradually increasing in relative size, becoming about twice as wide as ventral lobes in posterior fifth of body.

Ventral cirri extending laterally to ends of ventral lobes throughout; originating slightly ectad of crotch where foot joins body (fig. 48, *c*).

Dorsal cirri (fig. 48, *b*, *c*) more than twice as long as dorsal lobes, attached to dorsal lobe on dorsal side, in line with axis formed by middle lobe and dorsal lobe. Falcigerous setae as in figures 48, *d*, *e*.

*Abnormality.*—A single specimen less than half as large, but with similar proportions and color markings, has a single enlarged prostomial antenna (fig. 48, *f*) in place of the usual paired antennae. Its parapodia (fig. 48, *g*) and setae compare well with those of a normal specimen of *N. neonigripes*.

*Holotype.*—U.S.N.M. no. 20201.

*Distribution.*—Kodiak, Alaska; Sonoma County, Calif.; Pacific Grove, Calif.

*Remarks.*—This species lies between *N. procera* Ehlers and *N. natans*, new species. It differs from both of these most conspicuously

in its short, blunt, pigmented parapodial lobes, as well as the anterior prolongation of the prostomium. It differs further in its dentition.

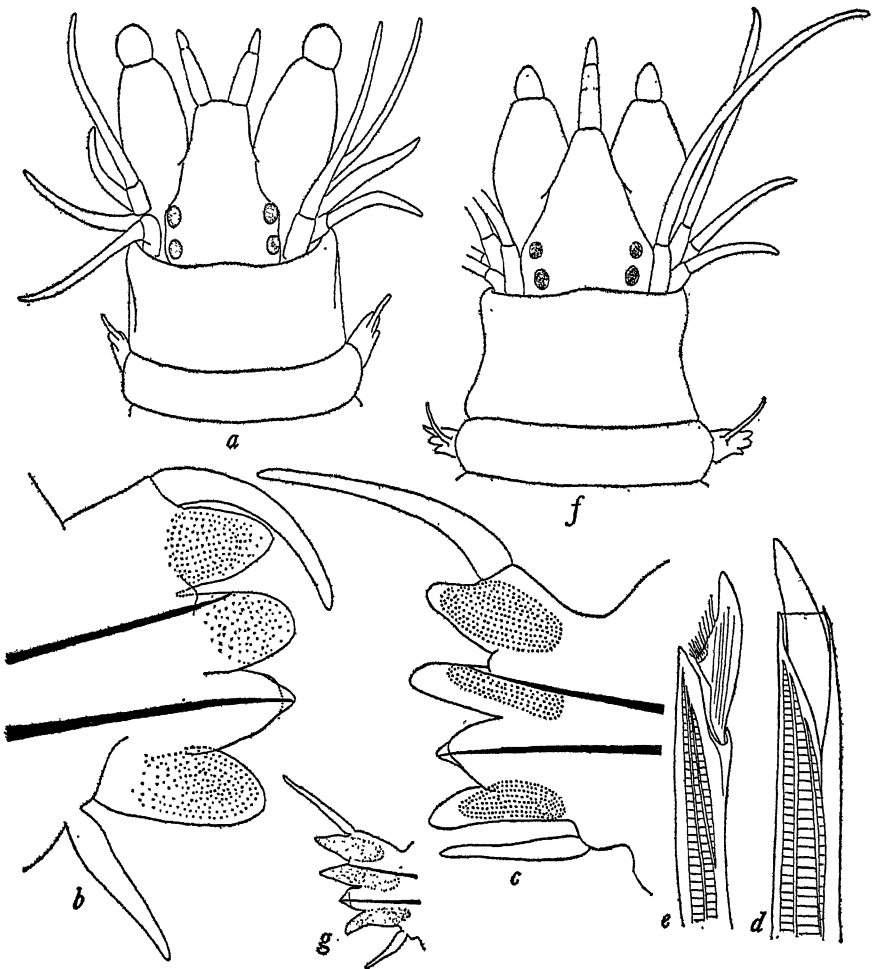


FIGURE 48.—*Nereis (Nereis) neonigripes*, new species: *a*, Anterior end in dorsal view,  $\times 11$ ; *b*, tenth parapodium in anterior view,  $\times 40$ ; *c*, posterior parapodium in posterior view,  $\times 40$ ; *d*, falcigerous homogomph notoseta,  $\times 333$ ; *e*, falcigerous heterogomph neuroseta,  $\times 333$ ; *f*, anterior end, in dorsal view of specimen with only one antenna,  $\times 40$ ; *g*, fortieth parapodium from specimen with abnormal prostomium,  $\times 40$ .

**NEREIS (NEREIS) EAKINI, new species**

**FIGURE 49**

*Nereis pelagica* IZUKA, 1912; *non* Linnaeus.

*Measurements*.—Length, 25–100 mm; width, 2–5.5 mm without parapodia, 4–7 mm with parapodia; number of segments, 42–78.

*Description.*—Prostomium (fig. 49, *a*) narrowest anteriorly, widest in posterior third; provided with four black or brownish eyes disposed on widened posterior portion of prostomium.

Antennae two-thirds as long as prostomium, proximally separated by distance equal to diameter of their bases, diverging distally, and extending to a point between distal end of palpode and its style.

Palpi compressed-cylindrical, attached to prostomium so as to leave a free area almost equal to width of prostomium between ectal bases of antennae; palpode thickened in basal third, tapering distally and terminating in a spherical palpostyle (fig. 49, *a*).

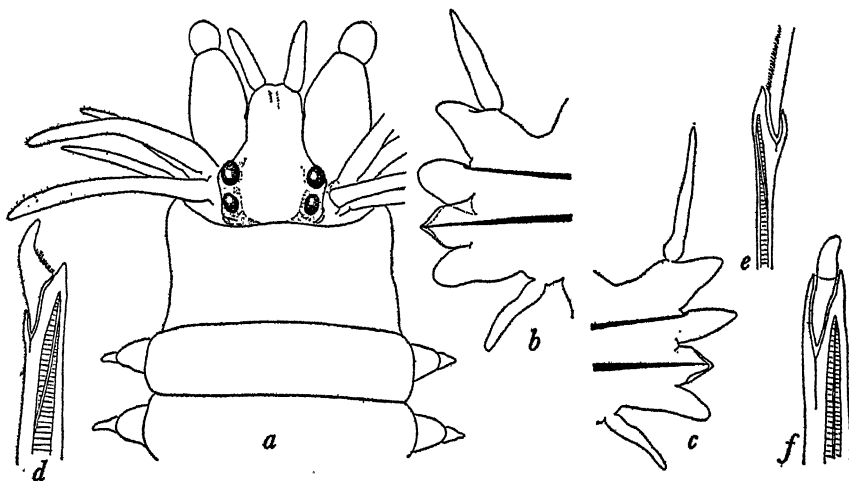


FIGURE 49.—*Nereis (Nereis) eakini*, new species: *a*, Anterior end in dorsal view,  $\times 13$ ; *b*, tenth parapodium in anterior view,  $\times 40$ ; *c*, posterior parapodium in posterior view,  $\times 40$ ; *d*, falcigerous heterogomph neuroseta,  $\times 333$ ; *e*, articulation of pointed heterogomph neuroseta,  $\times 333$ ; *f*, falcigerous homogomph notoseta,  $\times 333$ .

Peristomium (fig. 49, *a*) dorsally seven-fifths as long as, and somewhat narrower than, or equally as wide as, segment 2; produced ventrally into a smooth lower lip, which extends slightly into second segment at the middle.

Paragnaths very numerous, dark or medium brown; area I with two to four small teeth in tandem; II with many round low cones, forming a longitudinal crescent between jaws; III with four to six teeth in a small transverse mass; IV with a large diagonal area of many round low teeth; V–VIII with a continuous band of many distinct, low, round cones of unequal sizes, completely covering basal half of oral ring, the largest cones on area VI, the smallest on the side of the oral opening.

Jaws deep, horny brown, with only three or four shallow teeth, which do not project from concave edge of jaw.

Parapodia anteriorly with dorsal and ventral lobes about equal (fig. 49, *b*) and subcylindrical, with dorsal and ventral cirri exceeding lobes in length; median parapodia with relatively larger and more conical dorsal lobes and longer, slenderer ventral lobe, with dorsal cirri relatively longer, distally extending beyond tips of setae; posterior parapodia similar to median parapodia except for further elongation of dorsal lobes and cirri (fig. 49, *c*).

Setae (fig. 49, *d-f*) all composite; pale amber, appendage deeper amber than shaft; falcigerous homogomph notosetae (fig. 49, *f*) first present in twentieth setiger, accompanied by homogomph pointed setae; at twenty-second setiger three or four homogomph notosetae replace all other dorsal setae, this order continuing to posterior end.

Anal cirri two, exceeding in length the longest dorsal cirri by about one-half.

*Holotype*.—U.S.N.M. no. 20203.

*Distribution*.—Pacific Grove, Calif. (type), collected by Dr. R. M. Eakin; Fort Bragg and vicinity, Calif.; a much larger specimen, agreeing well with the California specimens, from Port Orchard, Wash. Dr. Eakin reported that his specimens were taken from the ambulacral groove of the starfish *Patiria miniata*.

*Remarks*.—The unusually large number of paragnaths on the oral ring and their disposition readily set this species apart from any other known species of this genus. In its parapodial and setal structures it is nearest to *N. neonigripes*, new species, and *N. natans*, new species.

NEREIS (NEREIS) NATANS, new species

FIGURE 50

*Measurements*.—Length, 8 mm including anal cirri; width, 0.65 mm at peristomium, 0.8 mm without, 1.9 mm with parapodia at seventh segment; number of segments, 51, including 13 anterior prenatatory, 25 natatory, 11 postnatatory, and 1 anal.

*Description*.—Prostomium (fig. 50, *a*) about as wide as long, narrowest at anterior end where antennae are attached; provided with four very large dark-brown bulging eyes (fig. 50, *a*), the two of each side almost touching.

Antennae (fig. 50, *a*) slightly longer than anterior base of prostomium at point of attachment; separated at bases; extending distally beyond the palpi.

Palpi cylindrical, with medioventral surfaces compressed, their ectal margins almost parallel (fig. 50, *a*); palpoles extending anteriorly only slightly beyond prostomium; palpostyles spherical, curved ventrad.

Peristomium about  $1\frac{1}{2}$  times as long as segment 2 (fig. 50, *a*) and as wide; smooth dorsally, ventrally forming a lower lip, which is

convex at both anterior and posterior margin and smooth except for a few shallow grooves; peristomial cirri short, the longest  $1\frac{1}{2}$  times as long as peristomium, the shortest slightly over half as long as the longest (fig. 50, *a*).

Paragnaths dark brown, bluntly pointed cones to low round plaques; area I with three tiny teeth in a transverse row; II with a patch of 8 to 10 larger teeth; III with a large lozenge-shaped patch of many closely crowded teeth; IV with a small patch of a few irregularly scattered teeth; V with none; VI with a tiny heap; VII-VIII with a continuous band of several, irregular rows of scattered cones.

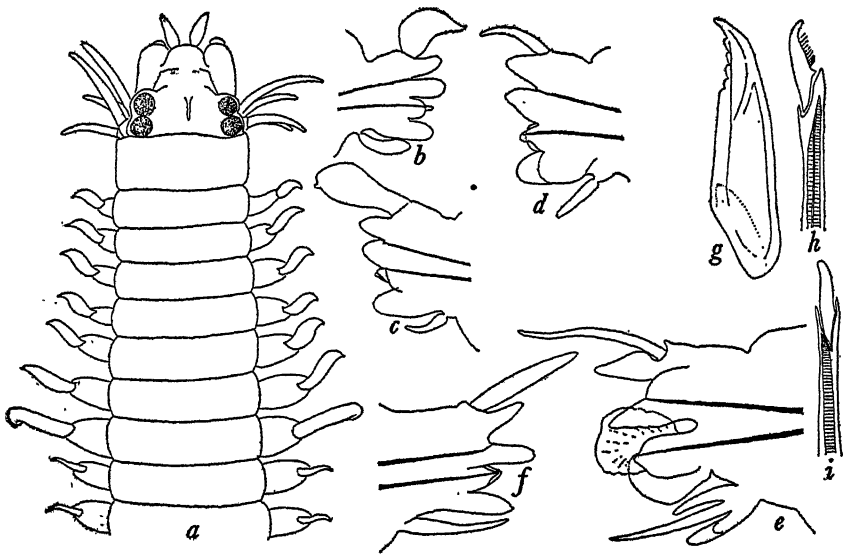


FIGURE 50.—*Nereis (Nereis) natans*, new species: *a*, "Head" and first 10 segments, parapodia diagrammatically represented to show increasing lengths of dorsal cirri and return to normal cirri at ninth segment,  $\times 26$ ; *b*, fourth parapodium,  $\times 40$ ; *c*, eighth parapodium,  $\times 40$ ; *d*, thirteenth parapodium,  $\times 40$ ; *e*, natatory parapodium from posterior three-fifths of body,  $\times 40$ ; *f*, a posterior postnatatory parapodium in posterior view,  $\times 80$ ; *g*, right jaw in dorsal view,  $\times 40$ ; *h*, falcigerous heterogomph neuroseta from prenatatory parapodium,  $\times 333$ ; *i*, falcigerous homogomph notoseta from postnatatory parapodium,  $\times 333$ .

Jaws (fig. 50, *g*) amber brown, translucent, curved strongly inward in distal half; with four teeth on inner edge.

Parapodia of segments 2-14 with lobes as in figure 50, *b-d*, and setae of normal form; segments 15-39 with natatory parapodia (fig. 50, *e*), those of segments 40-50 (fig. 50, *f*) similar to those preceding segment 14; dorsal cirri of first seven setigerous segments gradually increasing in size (fig. 50, *a*); ventral cirri thickest on first setigerous segment, gradually decreasing in size and becoming normal at ninth segment; natatory parapodia about two-thirds

as long as width of body, provided with dorsal cirri, which extend to edges of special respiratory lobes. Natatory and postnatatory regions characterized by thick, glandular, paired areas above dorsal bases of parapodia.

Anus provided with two long thick cirri extending posteriorly, each about as long as last five setigerous segments, and two globular dorsal cirri, each slightly wider than half of body width at their point of attachment.

Setae all composite; falcigerous homogomph notosetae and neurosetae as in figure 50, *h, i*.

*Holotype*.—U.S.N.M. no. 20204.

*Locality*.—Three specimens from Moss Beach, San Mateo County, Calif., collected in tow with electric light between 8 and 9 p. m., July 1934.

*Remarks*.—This species is placed in the series of *Nereis* (sensu stricto) because of the presence of homogomph notosetae in posterior parapodia. Atokous specimens have not been observed. With respect to the structure of its postnatatory parapodia, it lies between *N. neoniigripes*, new species, and *N. eakini*, new species.

NEREIS (CERATONEREIS) TUNICATAE, new species

FIGURE 51

*Measurements*.—Length, about 20 mm; width, 1 mm, including parapodia between segments 15–25; number of segments, 68 in one specimen, 70 in another.

*Description*.—Prostomium relatively small, with region anterior to eyes longer than broad; the posterior third provided with four black eyes disposed in a rectangle, the anterior pair the larger.

Antennae extending distally beyond palpophores, almost contingent at their bases, diverging slightly distally.

Palpi broader than width of prostomium, thick, touching ventrally; palpostyles hemispherical.

Peristomium  $11\frac{1}{2}$  times as wide as segment 2, constricted in anterior third; a smooth ring except for three shallow grooves laterally and a few short grooves at the oral opening.

Peristomial cirri short, the longest less than twice as long as peristomium, annulated in distal half; the shortest as long as peristomium; cirrophores smooth rings, weakly pigmented.

Paragnaths absent from oral ring; area I with none; II with three tiny cones; III with one minute cone; IV with three small cones in a transverse row.

Jaws pale amber, translucent, with five teeth.

Parapodia (fig. 51, *a, b*) anteriorly with conspicuous dorsal and ventral lobes, which are equal or subequal (fig. 51, *a*); median para-

podia with dorsal and ventral lobes becoming increasingly smaller, but with relatively larger setal lobes; posterior parapodia with dorsal rami increasing in relative size (fig. 51, *b*) and ventral rami decreasing; sixty-fifth parapodium as in figure 51, *b*; falcigerous homogomph setae (fig. 51, *c*) in posterior notopodia.

Anal cirri two, as long as last four segments, somewhat annulated in distal half.

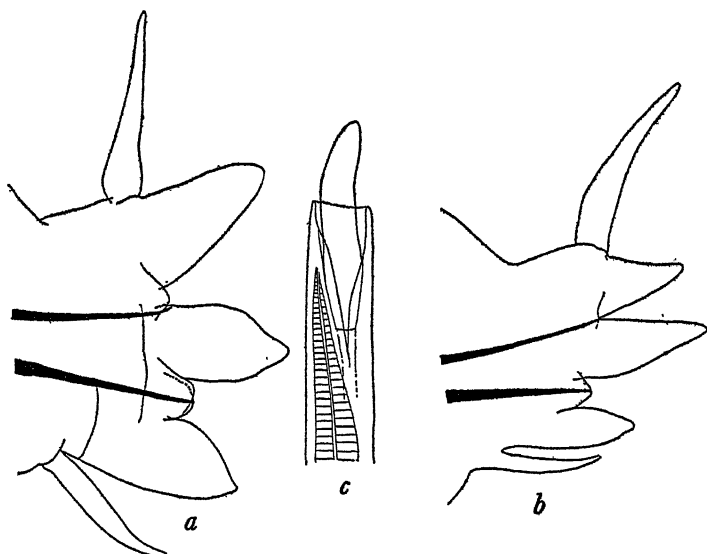


FIGURE 51.—*Nereis* (*Ceratoneis*) *tunicatae*, new species: *a*, Tenth parapodium in anterior view,  $\times 80$ ; *b*, posterior parapodium in anterior view,  $\times 80$ ; *c*, falcigerous homogomph notoseta from posterior parapodium,  $\times 730$ .

*Color*.—A segmentally arranged pattern on dorsum of anterior half of body, fading after the tenth segment and disappearing by the thirtieth, consisting of a broad, transverse band of purplish brown, broken by one median and two pairs of lateral pale blotches; the parapodial lobes with similar pigment.

*Holotype*.—U.S.N.M. no. 20205.

*Locality*.—From a compound tunicate, embedded in the matrix; no tube observed; Tomales Bluff, near Dillon Beach, Calif.

#### NEREIS (NEANTHES) SALTONI, new species

FIGURE 52

*Measurements*.—Length, 30–50 mm; width at tenth segment, 2.5 mm without, 4 mm with, parapodia; number of segments, to 115.

*Description*.—Prostomium (fig. 52, *a*) much as in *Nereis* (*Neanthes*) *virens* Sars; with a median emargination extending from



anterior end to between anterior eyes; provided with four widely separated eyes with lenses.

Antennae (fig. 52, *a*) almost contingent at their inner bases; about half as long as prostomium; directed forward.

Palpi stout, subcylindrical, with a transverse groove at distal third (fig. 52, *a*); palpostyle spherical, about half as wide as distal end of palpode.

Peristomium (fig. 52, *a*) dorsally about as long as segment 2, convex at anterior medial margin; slightly wider than segment 2; produced ventrally to form a strongly grooved lower lip, its posterior margin convex; peristomial cirri elongated, the cirrophores almost half as long as the palpi, transversely wrinkled; styles smooth, the longest reaching to eighth setigerous segment, the shortest beyond the palpostyle.

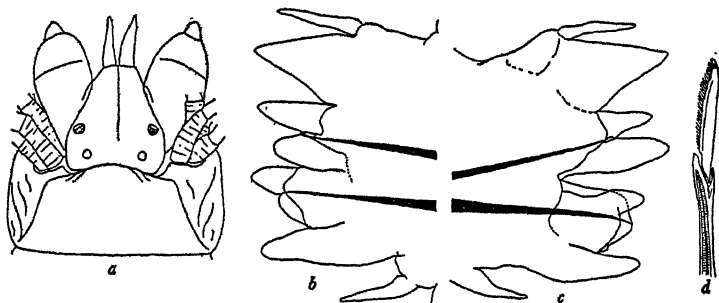


FIGURE 52.—*Nerets (Neanthes) saltoni*, new species: *a*, Prostomium and peristomium in dorsal view,  $\times 12$ ; *b*, tenth parapodium in posterior view,  $\times 27$ ; *c*, fortieth parapodium in anterior view,  $\times 27$ ; *d*, falcigerous neuroseta from median parapodium,  $\times 222$ .

Paragnaths numerous, black, mostly small well-separated pointed cones, the largest present on areas II, V, and VI; area I with one to four medium-sized blunt cones; area II with an oblique patch of about 15 teeth disposed in three rows; area III with a broad rectangular area of 20 to 25 smaller teeth; area IV with an irregular crescent of 15 to 20 cones intermediate in size between those of areas II and III; area V with one to five pointed cones; area VI with a rounded heap of 10 to 13 pointed cones; area VII to VIII with a continuous band of pointed cones in two or four irregular rows, most cones ventrally. Jaws thin, horny brown, with about eight teeth.

Parapodia (fig. 52, *b*, *c*) with elongated, fingerlike, equal or subequal lobes, except for the dorsal lobes, which are over twice as wide as the ventral lobes throughout length of body; posterior parapodia relatively longer and slenderer; dorsal lobe characteristically with its distal portion approximating in shape an equilateral triangle; dorsal cirri extending distally to beyond middle of dorsal lobe (fig. 52, *a*, *b*).

Setae all composite; falcigerous neurosetae (fig. 52, *c*) with a short appendage, the ratio of length to width being 10:1 or less.

*Holotype*.—U.S.N.M. no. 20206.

*Locality*.—Collected in quantity by Prof. S. F. Light, of the University of California, from Salton Sea, Calif. It is apparently a common species there. Professor Light found great numbers of dead individuals lying along the shore. Three weeks earlier, Dr. J. E. Hill had collected numerous 3-5-segmented polytrochs from Salton Sea, presumably of the same species. The suggestion of a reproductive swarming is obvious. The living worms were present in great numbers in the firm muddy sand, which forms the bottom at least near the shore at Date Palm Beach where the collections were made. Numerous young individuals were seen, and these like the older ones were enclosed in a tube of debris and slime.

*Remarks*.—This species is closely related to *Nereis* (*Neanthes*) *virens* Sars. It is separable from that species in the following characters: (1) It has a much greater number of paragnaths on both maxillary and oral rings, (2) the shape of the parapodial lobes differs strikingly, especially of the dorsal lobes, (3) parapodia lack parapodial granules as typical of *N. virens* Sars, and (4) the appendage of the falcigerous setae has a length to width ratio of 10:1 as against 15:1 or over, as typical for *N. virens* Sars.

NEREIS (EUNEREIS) LONGIPES, new species

FIGURE 53

*Measurements*.—Small. Length, 17 mm; width, 1 mm without, 2 mm with, parapodia at twelfth setigerous segment; number of segments, 79.

*Description*.—Prostomium (fig. 53, *a*) longer than wide, with narrowed, subquadrangular, anterior portion, which is shorter than the posterior portion; provided with four large red eyes with lenses.

Antennae (fig. 53, *a*) almost half as long as prostomium; well separated at their bases.

Palpi moderately large, tapering distally; palpostyles bluntly conical.

Peristomium as wide as segment 2; dorsally with paired triangular projections extending forward over prostomium (fig. 53, *a*); laterally with a groove that separates an anterior portion that turns ventrally to produce fleshy lobes at sides of the oral opening, and a posterior portion that forms a moderately thick lower lip; peristomial cirri short (fig. 53, *a*), the longest extending beyond distal ends of palpi, the shortest about one-third as long.

Paragnaths completely lacking from the maxillary ring, also from areas V and VI; VII and VIII with six brown cones set in a transverse row, two cones to each area.

Jaws pale brown, horny at distal edge, without teeth but with about eight shallow crenulations on the concave edge.

Parapodia (fig. 53, *a-d*) of normal length in anterior part of body, increasing in length in middle region of body and becoming as long as width of body in posterior third; dorsal cirri in anterior parapodia as long as, or slightly longer than, dorsal lobes (fig. 53, *a-c*); in anterior parapodia the dorsal lobes and cirri diverge distally; from about the twenty-first segment the posterior acicular lobe of the ventral ramus develops a large saclike lobe (fig. 53, *d*), which projects caudad; these lobes increase in size more posteriorly and come to fill entire space between consecutive parapodia in last 12 setigerous segments.

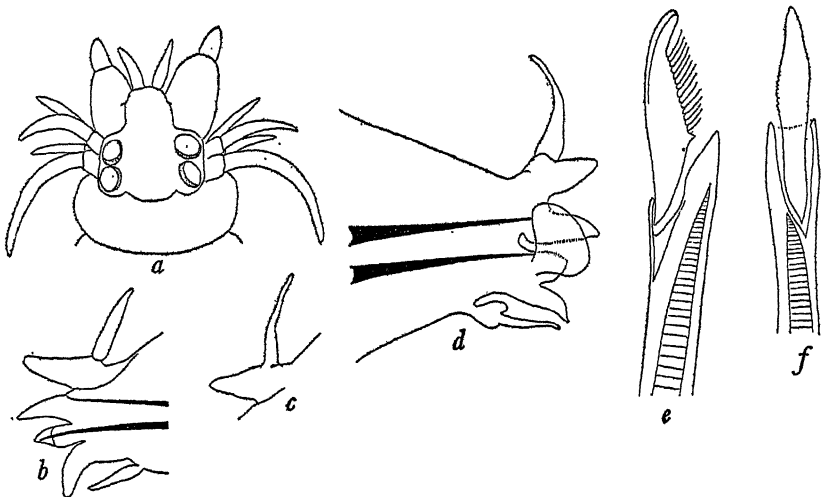


FIGURE 53.—*Nereis (Eunereis) longipes*, new species: *a*, Prostomium and peristomium in dorsal view,  $\times 26$ ; *b*, tenth parapodium in posterior view,  $\times 40$ ; *c*, dorsal cirrus and dorsal lobe from twentieth parapodium,  $\times 40$ ; *d*, epitokous parapodium from posterior half of body in posterior view,  $\times 40$ ; *e*, falcigerous heterogomph neuroseta from posterior parapodium,  $\times 875$ ; *f*, homogomph notoseta from posterior parapodium,  $\times 875$ .

Setae with the usual heterogomph and homogomph pointed setae and falcigerous heterogomph neurosetae (fig. 53, *e*) and homogomph notosetae (fig. 53, *f*) in posterior parapodia.

Anal cirri two, long, as long as last four setigerous segments.

*Holotype*.—U.S.N.M. no. 20207.

*Locality*.—From crevice in a large rock in 10 feet of water at low tide in a cove at Moss Beach, San Mateo County, Calif.

*Remarks*.—*Nereis (Eunereis) longipes* approaches *N. (E.) hardyi* Monro from southern South America. It differs from that or any other known species in head proportions, the ventral parapodial lobes are relatively longer, and the neuropodial lobes of the posterior parapodia are unique.



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FOUR NEW SPECIES OF CHALCIDOIDEA PARASITIC ON  
CACTUS INSECTS

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Agriculture*

THE following apparently new species of parasitic Hymenoptera were all reared by representatives of the Australian Prickly Pear Board in the course of their extensive investigations of cactus insects in Texas and Mexico during the past several years.

Family CALLIMOMIDAE

Genus CALLIMOME Spinola

CALLIMOME BIFASCIIPENNIS, new species

Differs from all other known North American members of the genus by having two very distinct brownish fasciae on the forewing, one adjacent to the venation at the point of union of submarginal and marginal veins, the other and larger one abutting on the apical one-third of marginal vein adjacent to the stigmal vein and extending obliquely distocaudad to the middle of the wing as a moderately broad and nearly uniform transverse stripe.

*Female*.—Length, excluding ovipositor, 3 mm; ovipositor sheaths 4.3 mm. Head strongly transverse, somewhat broader than thorax at tegulae; vertex and frons with fine alveolate sculpture; face with a weak median ridge, weakly reticulated and also covered with broad shallow indentations, which are arranged in more or less

irregular transverse rows, each pit bearing a conspicuous appressed silvery-white hair at its center; antennal scape cylindrical, pedicel a little shorter than first funicle joint, ring joint as long as broad, first to fifth funicle joints longer than broad, sixth and seventh funicle joints quadrate, club about as long as two preceding funicle joints and slightly broader than funicle; malar space equal to a little less than half the eye height; ocellocular line a little longer than the diameter of an ocellus. Mesoscutum, scutellum, and axillae with fine and nearly uniform alveolate sculpture, the scutellum with a delicate cross furrow; propodeum practically smooth and without carinae; mesepimeron and metapleuron smooth and polished; hind coxae outwardly strongly sculptured; stigmal vein sessile, postmarginal nearly twice as long as stigmal and about one-sixth as long as marginal; abdomen about as long as head and thorax, narrower than thorax, very faintly sculptured, the first to fifth tergites deeply emarginate apically. Head above and dorsum of thorax dull brassy green; face dull purplish; occiput and temples a little brighter metallic green than vertex; scape testaceous; flagellum brownish black; pronotum bluish; pleura violaceous; mesosternum black; propodeum shining green; posterior coxae strongly violaceous, the anterior and median pairs less strongly so; all femora dark brownish, with a slight metallic luster; all tibiae and tarsi testaceous; wings hyaline except for the two brownish fasciae already described; abdomen above bright green basally, beyond the first tergite and beneath aeneous black; ovipositor sheaths black.

*Male*.—Length 2.45 mm. Similar to the female except that the abdomen is about as long as the thorax, the scape is rather strongly tinged with metallic, and the pleura not so strongly violaceous.

*Type locality*.—Mexico City, Mexico.

*Type*.—U.S.N.M. no. 51447.

Described from five females and one male, said to have been reared in April 1928 by L. H. Hitchcock from *Phytophaga* sp. infesting *Opuntia*.

## Family EURYTOMIDAE

### Genus RILEYA Ashmead

#### RILEYA OPUNTIAE, new species

In the key to species of the genus *Rileyia* published by me in 1918,<sup>1</sup> this species runs directly to couplet 14 and of the two species occurring in that category agrees best with *similaris* Gahan. It differs from *similaris* by having the parapsidal grooves effaced, the striations of face stronger and extended upward somewhat beyond the lower margin of the antennal depression, the antennal flagellum dis-

<sup>1</sup>Proc. Ent. Soc. Washington, vol. 20, p. 137, 1918.

tinctly a little longer and less robust, the first funicle joint a little longer than broad, the second and third joints about as long as broad, the fourth and fifth somewhat broader than long. It may be distinguished at once from *americana* Girault by the fact that the distance between the posterior ocelli is distinctly longer than the distance between the lateral ocellus and the eye margin.

*Female*.—Length 3.4 mm. Face medially weakly shagreened, somewhat shining except immediately below the antennal fossae; sides of face with strong striae, which converge at the anterior margin on either side of the clypeus; frons, vertex, occiput, temples, and cheeks strongly shagreened; carina separating face from cheeks strong and continued upward along the posterior eye margin nearly to top of eyes, the space between it and the eye very finely transversely striated; carina separating cheeks and temples from occiput also strong and bordered by a foveolate groove; ocellocular line equal to about one and one-half times the diameter of an ocellus, about two-thirds as long as postocellar line. Thorax dorsally sculptured like the head; prothorax strongly convex, longer than mesoscutum, its dorsal aspect separated from the pleural aspect by a weakly carinate line; parapsidal grooves entirely absent; scutellum with a distinct transverse ridge or fold at about its apical third, this fold sometimes interrupted medially; propodeum with a strong transverse carina, the area in front of this carina divided at the middle by a short median longitudinal carina and each half again divided by a curved carina about halfway between the spiracle and the median line, the area behind the transverse carina nearly uniformly coarsely longitudinally striated. Postmarginal vein about twice as long as stigmal and about three-fourths as long as marginal. Abdomen distinctly longer than head and thorax, acuminate at apex; first tergite nearly circular and perfectly smooth, second about one-fourth as long as first and also smooth, third approximately twice as long as second and distinctly finely reticulated; fourth distinctly longer than the three preceding combined and uniformly finely reticulated, fifth and sixth subequal, each about as long as the third and sculptured like the fourth; seventh a little longer than the sixth, sharply triangular; ovipositor tip barely exposed. Scape, mandibles, palpi, tegulae, trochanters, apical one-third to one-half of all femora, all tibiae, and all tarsi testaceous, the tarsal claws dark; abdomen basally beneath more or less brownish; wings hyaline, the venation brownish testaceous; remainder of insect dull black.

*Male*.—Unknown.

*Type locality*.—Uvalde, Tex.

*Type*.—U.S.N.M. no. 51448.

Described from five females, said to have been reared from *Asphondylia opuntiae* Felt in April 1928 by L. H. Hitchcock.

## Family PTEROMALIDAE

## Genus NEOCATOLACCUS Ashmead

## NEOCATOLACCUS MONEILEMAE, new species

Similar in size, shape, and general appearance to *N. tylodermae* Ashmead but distinguished at once by the partially carinate margin of the pronotum, the much more delicate transverse carina on the propodeum, and the much less conspicuous vestiture of the thorax, the hairs being slenderer and nearly straight, not coarse and recurved or recumbent as in *tylodermae*.

*Female*.—Length 4 mm. Head strongly transverse, a little broader than thorax at tegulae, strongly and nearly evenly alveolately sculptured except the clypeal region, which is convergently striated; clypeus with distinct median sinus; right mandible quadridentate, the left tridentate; malar space equal to about half the eye height, malar groove absent or very indistinct; ocelli in a low triangle, the ocellocular line equal to a little more than twice the diameter of an ocellus; antennae inserted at middle of head; scape cylindrical; pedicel about twice as long as thick at apex; three very distinct transverse ring joints; funicle 5-jointed, the first joint longer than pedicel and more than twice as long as thick, following joints successively decreasing in length, the fifth a little longer than thick; club 3-jointed, not broader than the funicle and about equal in length to the two preceding funicle joints. Thorax sculptured like the head, moderately robust; pronotum strongly transverse, sharply carinately margined anteriorly at the middle, the carina fading out laterally before attaining the dorsolateral margins; mesoscutum much broader than long with parapsidal grooves sharply impressed for about two-thirds its length, absent posteriorly; scutellum about as broad as long, rounded at apex, and immargined; propodeum a little less than half as long as scutellum, alveolately sculptured but the alveolae not quite so deep as on scutellum and mesoscutum, with a distinct median longitudinal carina, and a delicate more or less obscure and somewhat sinuous transverse fold extending across the middle and terminating at the lateral folds, the latter represented anteriorly by a large and moderately deep depression on each side about midway between the spiracle and the median longitudinal carina; mesopleura sculptured like the mesonotum; metapleura and hind coxae sculptured about like propodeum; hind tibia with two spurs, the inner of which is a little longer than the outer; forewings not reaching to apex of abdomen, the stigmal vein a little less than half as long as marginal, postmarginal equal to about two-thirds of marginal; abdomen pointed ovate, distinctly longer than head and thorax, as broad as thorax, the first tergite polished, following tergites weakly lineolated and shining; ovipositor sheaths barely extending beyond

apex of seventh tergite. Vestiture of head and thorax consisting of moderately long grayish hairs which are mostly straight and not at all flattened, only those on the frons somewhat recurved. Color of head and thorax greenish black; mesoscutum and scutellum dull black medially, the scapulae, median lobe of mesoscutum laterally, axillae, and scutellum laterally faintly tinged with greenish; propodeum and metapleura distinctly greenish; mesopleura mostly black; wings hyaline, venation brownish, tegulae testaceous, all coxae concolorous with the thorax; femora brownish testaceous, the posterior pair usually more or less metallic on basal half or two-thirds; tibiae and tarsi all reddish testaceous; antennal flagellum black, scape and pedicel reddish testaceous; abdomen above tinged with green on first tergite, the rest of dorsum bright copper-colored; ventral side less strongly copper-colored.

*Male*.—Length 3 mm. Antennae with only two ring joints, the funicle 6-jointed; first funicle joint about as long as pedicel, a little longer than broad, second a little longer than first but slightly shorter than third, which is nearly twice as long as broad, fourth and fifth subequal and each about as long as second, sixth joint a little shorter than preceding; club 3-jointed, about as long as two preceding funicle joints and not thicker than funicle; ocellular line not quite as long as the long diameter of a lateral ocellus; propodeum a little longer than half the length of scutellum, the transverse carina or fold very distinct, the median longitudinal carina usually weak or incomplete; abdomen about as long as thorax, not as broad as thorax, subelliptical, with a short smooth petiole. Antennal scape, pedicel, and first five funicle joints testaceous; sixth joint of funicle and the club dark brown or blackish; abdomen with a pale spot embracing apex of first, all of second, and base of third tergites. Otherwise like the female.

*Type locality*.—Uvalde, Tex.

*Type*.—U.S.N.M. no. 51449.

Described from 26 females and 7 males reared from cocoons of *Monilema ulkei* Horn, June 8, 1929, by R. C. Mundell.

## Family EULOPHIDAE

### Genus TETRASTICHUS Haliday

#### TETRASTICHUS GERSTAECKERIAE, new species

Females of this species are distinguished with difficulty from those of *T. malacosomae* Girault but apparently differ by having the antennal depression (scrobes) divided medially by a low sharp ridge extending from between the bases of the antennae to the upper extremity of the depression and by having the apex of the forewing evenly rounded and with a very short marginal fringe. In all the 24 specimens of *malacosomae* available for examination the head is col-



lapsed, but apparently the scrobes are not at all separated, while the forewing is rather abruptly rounded or subtruncate at apex, and the marginal fringe is not especially short, being approximately half as long as the stigmal vein. The males may be distinguished at once from those of *malacosomae* by the fact that the scape is distinctly thicker and the flagellum shorter.

*Female*.—Length 2 mm. Moderately slender and elongate, the abdomen more than one and one-half times as long as head and thorax combined. Antennal scape normal; pedicel a little more than twice as long as thick at apex; ring joints minute; first funicle joint about as long as pedicel, second and third funicle joints subequal and each a little shorter than the first; club 3-jointed, very slightly thicker than funicle and in length subequal to the two preceding funicle joints. Head nearly uniformly sculptured; cheeks very nearly as long as height of eyes; ocellular line about equal to diameter of an ocellus. Thorax dorsally with fine, irregular, shallow lineation, more or less shining medially; median groove on mesoscutum distinct; propodeum medially smooth and very short, laterally weakly sculptured and longer; forewings not reaching to apex of abdomen, evenly rounded at apex, the marginal fringe much shorter than half the length of stigmal vein; postmarginal vein entirely absent. Abdomen fully twice as long as thorax, acute at apex, weakly sculptured and thickly studded with rather conspicuous, pale, stiff hairs; ovipositor extending a little beyond apex of seventh tergite which is acutely triangular. Head, thorax, and abdomen brownish black, distinctly but not strongly tinged with metallic green; scape pale yellowish, flagellum brownish testaceous, the pedicel dark brown above; mandibles, clypeus, and narrow oral margin reddish; wings hyaline, venation testaceous, tegulae dark; all coxae and femora concolorous with the thorax; trochanters, apices of all femora, all tibiae, and tarsi pale yellowish; ovipositor sheaths black.

*Male*.—Length 1.5 mm. Antennal scape distinctly thickened, approximately three times as long as broad, deeply channeled beneath for its whole length; funicle 4-jointed, the first joint about equal to the pedicel in length, about one and one-half times as long as broad; second joint subequal to the first; third and fourth joints subequal and subquadrate; club as long as two preceding joints; forewings extending distinctly beyond apex of abdomen; abdomen ovate, about as long as head and thorax. Other characters as in the female except that the scape is entirely fuscous.

*Type locality*.—Texas, probably Uvalde.

*Type*.—U.S.N.M. no. 51450.

Described from three females and one male reared in June 1929 from *Gerstaeckeria porosa* LeConte.

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NEW TERTIARY FORAMINIFERA OF THE GENERA  
OPERCULINA AND OPERCULINOIDES FROM NORTH  
AMERICA AND THE WEST INDIES

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and  
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THE SPECIMENS on which the species described herein are based have been in the senior author's hands for several years, some of them since 1920. Suites to serve as cotypes had been selected, some photographs for illustrating the species were taken, and, except for *Operculinoides antiguensis*, manuscript names were applied to them, but the descriptions were not written. The final preparation of this paper for publication was done jointly. Seven new species are herein described, as follows:

*Operculina tuberculata*: Upper Eocene, Tantoyuca formation, Tampico Embayment, Mexico.

*Operculinoides advenus*: Upper Eocene, equivalent of Tantoyuca formation, Tampico Embayment, Mexico.

*Operculinoides vicksburgensis*: Oligocene, Byram calcareous marl of Mississippi and Alabama.

*Operculinoides semmesi*: Oligocene, Mesón formation, Tampico Embayment, Mexico.

*Operculinoides antiguensis*: Oligocene, Antigua formation, island of Antigua, and probably also Meson formation, Tampico Embayment, Mexico.

*Operculinoides forresti*: Oligocene, Antigua formation, island of Antigua.

*Operculinoides tuapanicus*: Miocene, Tuxpan formation, Tampico Embayment, Mexico.

All types are deposited in the United States National Museum.

The species of *Operculina* and *Operculinoides* here described do not exhaust all the species that should be described. There is at least one other in the Mesón formation of the Tampico Embayment, but material for adequately characterizing it is not now available.

The limits of the variation of the species designated as *Operculinoides semmesi* and *O. antiguensis* are not yet definitely fixed. The notes made under the caption "Remarks" indicate perplexities that require further consideration.

Our thanks are due R. Wright Barker for telling us the stratigraphic horizon of *Operculina tuberculata*; to Ursel S. Armstrong for making some of the preparations; and to W. O. Hazard, of the United States Geological Survey, and E. C. LaFond, of the Scripps Institution of Oceanography, for making the photographs for the plates.

#### Genus OPERCULINA d'Orbigny

*Operculina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 281, 1826.

#### OPERCULINA TUBERCULATA, new species

#### PLATE 35, FIGURES 1-4

Test small, with a peripheral keel, compressed, coils expanding slowly. Diameter from outer edge of aperture through center, 1.9 mm; diameter at right angles to line through aperture, 1.7 mm; thickness through center, about 0.4 mm.

The number of chambers in the final whorl of a specimen 1.6 mm in diameter is 16; the total number of coils in the same specimen is 3. The chamber walls are very slightly curved for their first half but are strongly and evenly recurved as they approach the periphery. The chamber walls are marked externally by costae and rather coarse granules, as shown in the figures. At the center there is a knob that is larger than the costal granulations, about 0.15 mm in diameter.

*Cotypes*.—U.S.N.M. no. 495188.

*Locality*.—Cortez Aguada well no. 2, depths 2,000–3,450 feet, 5.3 km northeast of Chalahuite and 7.2 km south of Aguada in property Aguada-San Diego Valdemar, Cantón of Ozuluama, State of Veracruz, Mexico. Cotypes from depths of 2,625 to 2,800 feet. Specimens received from Dr. W. S. Adkins, of the Aguila Co.

*Geologic horizon*.—Upper Eocene, Tantoyuca formation.

*Remarks.*—This species is closely related to *O. mariannensis* Vaughan (1928, p. 158) from the upper Eocene Ocala limestone of Florida, from which it is distinguished by its thicker, more robust form, its larger number of chambers, and its more evolute coiling. There are 11 or 12 chambers in the final coil of *mariannensis*, while slightly smaller specimens of *tuberculata* have 16 or 17. The granulations are coarser and the intercostal areas narrower in typical specimens of *tuberculata*.

#### Genus OPERCULINOIDES Hanzawa

*Operculinoides* HANZAWA, Tōhoku Imp. Univ. Sci. Rept., ser. 2 (Geol.), vol. 18, no. 1, p. 18, 1935.

*Genoholotype.*—*Nummulites willcoxi* Heilprin.

Hanzawa says: "On examining the foregoing listed specimens of *Operculina* [4 species] from America, I found that they all differ from either *Operculina complanata* (senso latu) or *Operculinella venosa* by being involute in the adult stage." A re-examination of *Operculinella venosa* shows that Hanzawa is correct in generically separating the American Tertiary species that have been referred to *Operculinella* Yabe from that genus and in proposing a new generic name for those typified by *Nummulites willcoxi* Heilprin. It seems better to refer such species as those represented by *Nummulites floridensis* Heilprin to another genus, *Assilina*, as Cushman has done; but it must be recognized that the members of the group need additional and more critical study.

#### OPERCULINOIDES ADVENUS, new species

##### PLATE 35, FIGURES 5-7

Test of medium size, involute, much compressed, the sides nearly parallel, with a very bluntly rounded periphery. Diameter from outer edge of aperture through center ranges from 1.9 to 3.6 mm; diameter at right angles to line through aperture ranges from 1.8 to 3.4 mm; thickness through center ranges from 0.3 to 0.5 mm. The surface is smooth, not ornamented, in well-preserved specimens; in weathered specimens the sutures appear as slightly raised lines, radiating with gentle curvature from the center to the periphery of the test.

A median section of a specimen 1.9 mm in diameter has 4 complete coils, with 22 chambers in the final coil; the specimen shown in plate 35, figure 6, is 3 mm in diameter and has 28 chambers in the last coil. The variation in the number of chambers in the final volution is from 20 to 28. The initial chamber is circular, about 88 $\mu$  in diameter. The chambers increase slowly but regularly in height.

In a specimen 2.3 mm in diameter the final chamber has a height of 0.5 mm.

The sutures are thin and radiate nearly straight from the center until near their proximal ends, where they recurve sharply. The curvature is such that the peripheral end of a suture nearly touches the adjacent one.

*Cotypes*.—U.S.N.M. no. 495189.

*Localities*.—At the base of the bluff on the Rio Pantepec 2.2 km south, 20° west, from the Buena Vista Hacienda House, Cantón Metlatoyuca, State of Puebla (M 71 V); cotypes, Rio Vinazco, right bank, 1.4 km (M 80 V) and 1.35 km (M 81 V) downstream from the road crossing from Buena Vista to Vinazco, Cantón Chicontepec, State of Veracruz. Collected by T. Wayland Vaughan for the Aguila Co.

*Geologic horizon*.—Upper Eocene, stratigraphic equivalent of the Tantoyuca formation. Associated with *Lepidocyclina tobleri* H. Douvillé, *L. trinitatis* H. Douvillé, and *L. macdonaldi* Cushman.

OPERCULINOIDES VICKSBURGENSIS, new species

PLATE 36

*Nummulites* sp. CUSHMAN, U. S. Geol. Surv. Prof. Pap. 129-E, pp. 100-101, pl. 24, fig. 4, 1922.

*Nummulites* sp. VAUGHAN, Geol. Soc. Amer. Bull., vol. 35, p. 787, 1924.

Test rather small, involute, compressed lenticular, outer surface without ornamentation except the traces of flexuous septal markings and a small area of clear shell material in the center from which the septa radiate. The test is nearly circular; the diameter from outer edge of aperture through center ranges from 1.3 to 3.1 mm; diameter at right angles to line through aperture ranges from 1.2 to 3 mm; thickness through center ranges from 0.3 to 0.6 mm. From the central area the test slopes very gradually to the bluntly rounded periphery.

An accidental median section of a specimen (pl. 36, fig. 2) 2.1 mm in diameter shows  $3\frac{3}{4}$  coils, with 18 chambers in the last coil. A thin section of a specimen (pl. 36, fig. 4) 2.5 mm in diameter has 22 chambers in the final volution; another section (pl. 36, fig. 5) has 4 coils and 25 chambers in the last coil. An uncut specimen 2.2 mm in diameter has 22 chambers showing at the surface, while another 2.8 mm in diameter has 26 chambers.

The sutures are moderately thick and radiate from the center with only slight curvature until near the periphery, where they bend backward evenly but sharply. There is a slight but regular increase in height of the chambers. The initial chamber is circular, about  $60\mu$  in diameter.

Plate 36, figure 4a, illustrates a decalcified Canada balsam impregnation of the canals in the marginal cord and an interseptal canal, magnified 210 times.

*Cotypes*.—U.S.N.M. no. 495190.

*Localities*.—Cotypes, road below National Cemetery, Vicksburg, Miss.; Robinson Quarry, sec. 19, T. 5 N., R. 9 E., 3 miles east of Brandon, Miss.; and one-fourth mile west of Floral Church, creek beneath bridge, S $\frac{1}{2}$  sec. 27, T. 3 N., R. 14 E., Covington County, Ala. All collected by Dr. C. Wythe Cooke.

*Geologic horizon*.—Byram calcareous marl, topmost formation of the Oligocene Vicksburg group at and near Vicksburg, Miss.

#### OPERCULINOIDES SEMMESI, new species

PLATE 37, FIGURES 10-13, probably FIGURE 14; PLATE 38, FIGURES 1, 2, probably FIGURES 5, 6

Test small, completely involute, lenticular, with a slightly extended thinner edge in fully adult perfect specimens. Diameter, 1.75-2.8 mm; thickness, 0.55-0.65 mm. In many specimens there is a small central knob.

The sutures on perfect specimens are somewhat raised and are curved as shown by the upper left specimen in plate 37, figure 10. The number of chambers in the specimen shown on plate 37, figure 11, is 18, and there are about 3 $\frac{1}{2}$  coils; the number in the specimen shown on plate 38, figure 2, is 19. Other specimens that appear to belong to the same species have fewer chambers, as few as 14 (pl. 37, fig. 14) or 15 (pl. 38, fig. 5). The proximal part of the chamber walls is nearly straight, while the distal part curves backward.

*Cotypes*.—U.S.N.M. no. 495191.

*Localities*.—The cotypes are from the arroyo in the center of Mesón Village, Cantón of Tuxpan, State of Veracruz, Mexico. Slightly worn but typical specimens were collected by T. Wayland Vaughan (M 36 V) at Azteca Incline, Zacamixtle, Cantón of Tuxpan, Veracruz. Other localities are on the east side of Rio Buena Vista, opposite La Ceiba crossing, along the slope, about 50 feet above the base of the bluff on the river (M 55 V and M 56 V). Specimens that appear to belong to this species were found at many localities where the Mesón formation is exposed, but to be sure of the identification thin sections are necessary. All the collections were made by geologists connected with the Aguila Co.

*Geologic horizon*.—Oligocene Mesón formation.

*Remarks*.—*O. semmesi* is a small, robustly lenticular species with a peripheral flange in perfect adult specimens. Apparently the chambers in the last coil range from 14 to 19, but larger suites of

good specimens may result in the separation of those specimens with 14 or 15 chambers from those with 18 or 19. At locality M 55 V, specimens with more chambers, 24 (pl. 38, fig. 3), and more robust tests (pl. 38, fig. 4) were collected. The similarity of these specimens to *O. semmesi* is obvious. They may represent a variant or they may belong to a closely related but different species. There may be several species of these small specimens of *Operculinoides* in the Mesón formation.

OPERCULINOIDES ANTIGUENSIS, new species

PLATE 38, FIGURES 7-10

Test of medium size, completely involute, lenticular, symmetrical or asymmetrical with reference to the median plane, edges acute. Diameter, 2.5-3.7 mm; thickness of a specimen 2.5 mm in diameter, 1 mm; of a specimen 3.25 mm in diameter, about 1 mm.

Sutures are of clear shell material, smooth and usually flush with the surface, radiating as gently curved lines from the center of the test to the periphery. Some of the sutures do not extend to the center but may converge in groups of three or four, with only one of the group extending to the center. In most specimens there is a small irregular area of clear shell material at the center of the test, and in a few specimens there is a slight boss of clear shell material.

The variation in the number of chambers in the final volution is from 29 in a specimen 3 mm in diameter to 33 in one about 3.5 mm in diameter. The chamber walls in median sections are somewhat sigmoid, the proximal end tending to curve forward slightly, the outer half strongly recurved.

*Cotypes*.—U.S.N.M. no. 495192.

*Localities*.—Cotypes, east side of Folly Hill, Nonsuch Bay, Antigua, collected by W. R. Forrest. The species is also found at numerous other localities in Antigua, one being in the lowest tilted beds, on the beach, at Lynch Point. What appears to be the same species was collected by T. Wayland Vaughan in the Mesón formation at locality M 18 V, Hacienda Santa Fé, Topila, near Tampico, Mexico. A specimen in a rock section from this locality is 2.33 mm in diameter and has between 26 and 28 chambers in the last coil.

*Geologic horizon*.—Oligocene Antigua formation in Antigua, British West Indies; and apparently also in the Oligocene Mesón formation of the Tampico Embayment, Mexico.

*Remarks*.—For some time the specimens to which the name *Operculinoides antiguensis* is here applied were placed in *O. semmesi*, but further study of the material has led to the conclusion

that two species should be recognized. Of the two, *antiguensis* is the larger, it has more numerous chambers, and in a median section the chamber walls tend to be sigmoid in plan.

OPERCULINOIDES FORRESTI, new species

PLATE 37, FIGURES 1-3

Test small, thin, compressed, with the sides nearly parallel; average specimens have a diameter from outer edge of aperture through center of test of about 2.5 mm; diameter at right angles to line through aperture, about 2.3 mm; the largest specimen observed had a diameter of about 3 mm. The thickness of an average specimen is about 0.3 mm. The surface is without ornamentation, except for the slightly raised recurved septa, which are more pronounced toward the periphery of the test.

A specimen with a diameter of 1.9 mm has 3 whorls, with 16 chambers in the final coil; another 2.6 mm in diameter has 4 whorls, with 21 chambers in the final whorl. The maximum number of chambers observed in the final volution was 24.

The chamber walls are but slightly curved for most of their length, radiating outward at 90° from the inner wall. As they approach the periphery they are sharply and strongly recurved, so that the end of one septum nearly touches the point of strong curvature of the adjacent septum.

In most specimens there is a very gradual increase in height as the chambers are added.

*Cotypes*.—U.S.N.M. no. 495193.

*Localities*.—Cotypes, tilted beds, east of Lynch's, Antigua; cliff, east of Gaynor's, Antigua, and many other Antiguan localities; collected by W. R. Forrest.

*Geologic horizon*.—Middle Oligocene, Antigua formation.

*Remarks*.—This species resembles closely *O. dia* Cole and Ponton (1930, p. 37) described from the Marianna limestone. They are similar in possessing rather fragile, compressed tests. Detailed comparison of *forresti* with topotype specimens of *dia* at once indicates that there are important differences. *O. forresti* is usually larger, has fewer chambers in the final volution, has a different type of curvature of the chamber walls and raised septal lines. Cole and Ponton's figures and topotype specimens of *dia* show that in that species the proximal parts of the chamber walls are gently curved, whereas in their distal parts the curvature is strong. The sutures of *O. forresti* are nearly straight from the center for about three-fourths of their length, but near the periphery they are strongly and sharply recurved.



*O. dia* is associated with *Lepidocyclina mantelli* (Morton) and is a characteristic species of the lower Oligocene, whereas *O. forresti* is associated with species of *Lepidocyclina* of middle Oligocene age.

OPERCULINOIDES TUXPANICUS, new species

PLATE 37, FIGURES 4-9

Test small, fragile, compressed, completely involute, without ornamentation except for traces of the septal lines. Diameter from outer edge of aperture through center ranges from 1.7 to 3.2 mm; diameter at right angles to apertural plane ranges from 1.5 to 3 mm; thickness through center ranges from 0.3 to 0.5 mm. The test is thickest through the center and slopes gradually to the rather sharply rounded periphery.

A section of a specimen about 1.6 mm in diameter has 3 coils, with 19 chambers in the final volution. Another specimen about 2.5 mm in diameter has  $3\frac{1}{2}$  coils, with 20 chambers in the final whorl.

The chamber walls are gently recurved except near the periphery, where they are sharply recurved. Some of the chamber walls vary from this pattern, as shown in the figures. These exhibit a gradual and regular recurvature throughout their length. The incorporation of two types of curvature in the same test gives the chambers an irregular appearance and shape.

*Cotypes*.—U.S.N.M. no. 495194.

*Locality*.—Roundtop, just southeast of the Plaza, City of Tuxpan, Veracruz, Mexico (M 76 S); collected by D. R. Semmes.

*Geologic horizon*.—Tuxpan formation of Miocene age.

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## EXPLANATION OF PLATES

## PLATE 35

- 1-4. *Operculina tuberculata*, new species, cotypes: 1, View of outside of three specimens,  $\times 12.5$ ; 2, median section,  $\times 15$ ; 3, transverse section,  $\times 20$ ; 3a, part of section represented by fig. 3,  $\times 107$ ; 4, transverse section,  $\times 20$ .

All from Cortez Aguada well no. 2. Fig. 1, depth 2,750-2,800 feet; fig. 2, 2,675-2,725 feet; figs. 3 and 4, 2,625-2,650 feet.

- 5-7. *Operculinoides advenus*, new species, cotypes: 5, View of outside of two specimens,  $\times 13$ ; 6, median section,  $\times 20$ ; 7, transverse section,  $\times 20$ . From M 80 V and M 81 V, Rio Vinazco, 1.35-1.4 km downstream from crossing of road from Buena Vista to Vinazco.

## PLATE 36

*Operculinoides vicksburgensis*, new species

1. View of outside of four specimens,  $\times 10$ .
2. Natural section in median plane,  $\times 20$ .
3. Section in median plane,  $\times 20$ .
4. Section in median plane impregnated with Canada balsam and decalcified,  $\times 20$ .
- 4a. Part of outer wall and chamber wall of specimen represented by fig. 4, showing canals filled with balsam,  $\times 210$ .
5. Section in median plane,  $\times 20$ .
6. Transverse section,  $\times 20$ .

Figs. 1-4a and 6, cotypes, from Byram calcareous marl, National Cemetery, Vicksburg, Miss. Fig. 5, from one-fourth mile west of Floral Church, Covington County, Ala.

## PLATE 37

- 1-3. *Operculinoides forresti*, new species, cotypes: 1, Outside of specimen,  $\times 10$ ; 2, median section,  $\times 20$ ; 3, transverse section,  $\times 20$ .  
All from tilted beds, east of Lynch's, Antigua.
- 4-9. *Operculinoides tuxpanicus*, new species, cotypes: 4, 5, Outside of two specimens,  $\times 10$ ; 6, 7, sections in median planes of two specimens,  $\times 15$ ; 8, 9, transverse sections of two specimens,  $\times 20$ .  
All from M 76 S, Roundtop, southeast of the Plaza, City of Tuxpan, Veracruz, Mexico.
- 10-13. *Operculinoides semmesi*, new species, cotypes: 10, View of outside of four specimens,  $\times 12.5$ ; 11, section in median plane,  $\times 20$ ; 12, 13, transverse sections of two specimens,  $\times 20$ .  
All from village of Mesón, Cantón of Tuxpan, Veracruz, Mexico.
14. Apparently *Operculinoides semmesi*, but with slightly fewer chambers in a whorl.  
From Mesón Village.

## PLATE 38

- 1, 2. *Operculinoides semmesi*, new species: 1, Outside of specimen,  $\times 10$ ; 2, median section,  $\times 15$ .

Both from M 36 V, Azteca Incline, Cantón of Tuxpan, Veracruz, Mexico.

- 3, 4. *Operculinoides* sp. cf. *O. semmesi*: 3, Median section,  $\times 20$ ; 4, transverse section,  $\times 20$ .

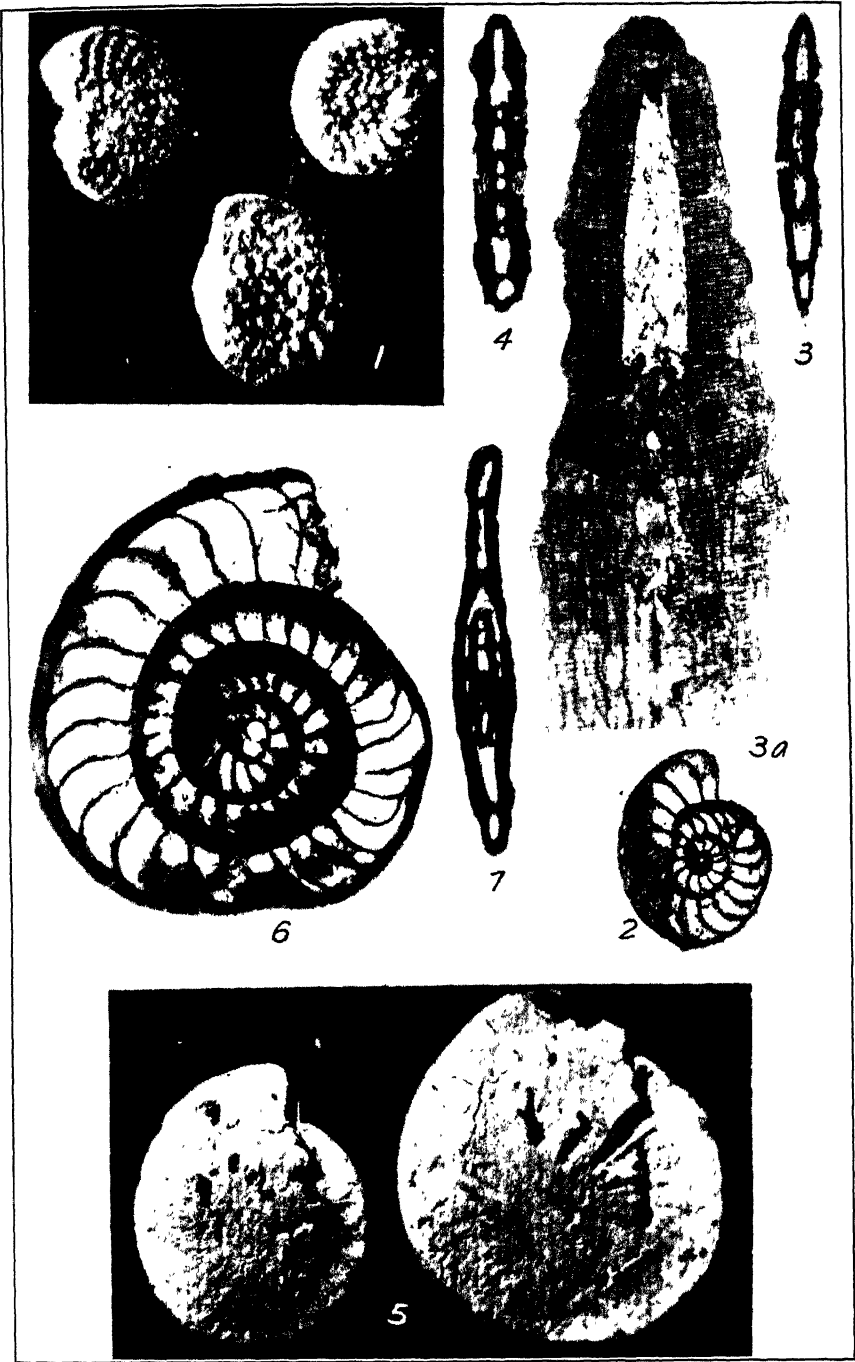
Both from M 55 V, 50 feet above base of bluff, up slope leading from La Ceiba crossing over Rio Buena Vista, Cantón of Tuxpan, Veracruz, Mexico. Note that in fig. 3 there are more chambers than in pl. 37, fig. 11, and in pl. 38, fig. 2, and that fig. 4 is thicker than specimen shown on pl. 37, figs. 12 and 13.

- 5, 6. Apparently *Operculinoides semmesi*: 5, Median section,  $\times 20$ ; 6, transverse section,  $\times 20$ .

Both from M 56 V, near La Ceiba crossing over Rio Buena Vista, same horizon as M 55 V.

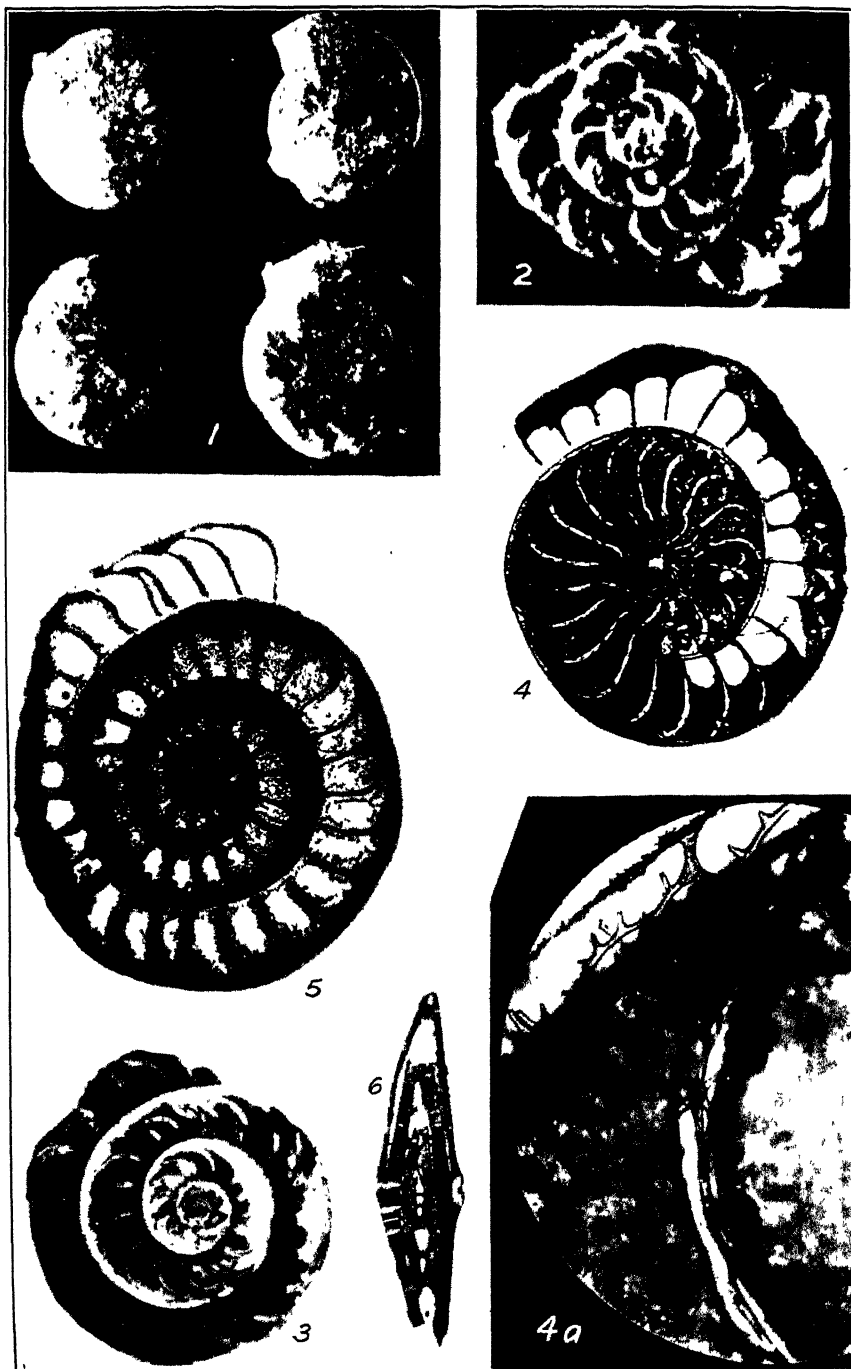
- 7-10. *Operculinoides antiguensis*, new species, cotypes: 7, View of outside of two specimens,  $\times 12.5$ ; 8, median section,  $\times 20$ ; 9, 10, vertical sections of two specimens,  $\times 20$ .

All from east side of Folly Hill, Nonsuch Bay, Antigua, British West Indies.



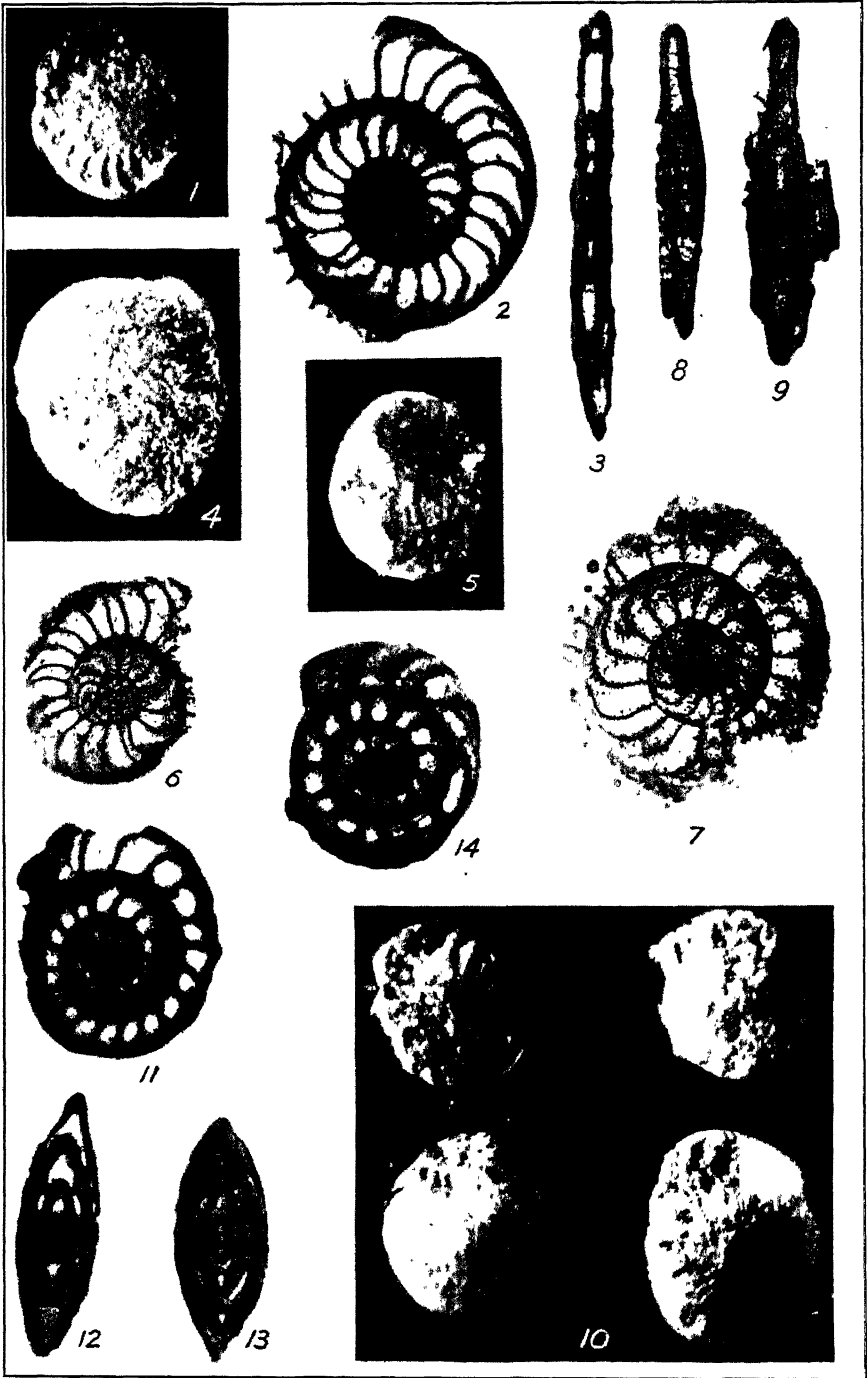
NEW TERTIARY FORAMINIFERA.

(FOR EXPLANATION OF PLATE, SEE PAGE 495 )



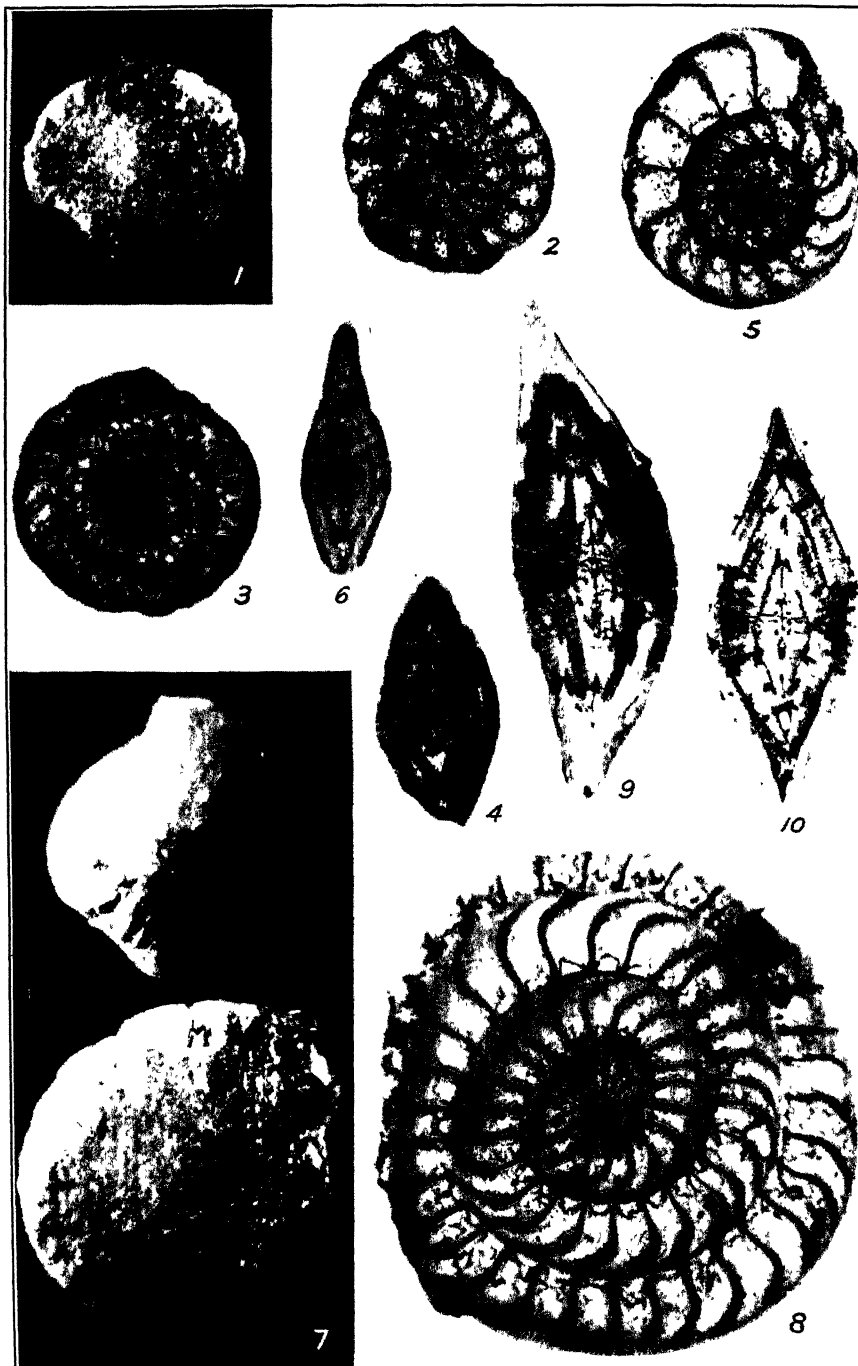
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(FOR EXPLANATION OF PLATE, SEE PAGE 496.)









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## REVIEW OF THE SEAHORSES (HIPPOCAMPUS) FOUND ON THE COASTS OF THE AMERICAN CONTINENTS AND OF EUROPE<sup>1</sup>

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### INTRODUCTION

THE PECULIAR little fishes known as seahorses in English-speaking countries, or generally by a translation of that term in other countries, have caught the popular fancy and attracted wide interest since ancient times, because of their bizarre appearance. Recognizable descriptions of seahorses may be traced back to the writings of the ancients.<sup>2</sup> Among the descriptions and even figured representations of aquatic monsters by the old writers, one comes across such circumstantial accounts that it becomes evident that they really believed in the existence of such monsters. In some cases at least they must have had in mind some hazy memory of a seahorse. Even in our sophisticated times the seahorse remains an object of absorbing interest. Specimens are often sold as souvenirs and are sometimes gilded and used as fobs for watch chains or for other ornamental purposes. No less than the popular attraction is the scientific interest in these fishes, because of their peculiar structure, their distinctive mode of life, and their unusual method of reproduction. Their peculiar, bony, jointed external skeleton, the shape of their head, which markedly resembles, in miniature, that of a horse, and their

<sup>1</sup> Published by permission of the United States Commissioner of Fisheries.

<sup>2</sup> For a discussion of old accounts and figures of seahorses, see Eastman, Ann. Rep. Smithsonian Inst. for 1915, pp. 349-357, 4 pls., 1916.

prehensile tail are so unfishlike that it is no wonder some of the early writers suggested their relationship to insects.

Think of a fish that has a prehensile tail and is able to suspend itself, monkeylike, by curling the end of it around the stems or branches of aquatic plants! Its extraordinary method of reproduction is no less remarkable than its peculiar structure. The male develops a large pouchlike organ on the underside of the body. In the process of reproduction the eggs are transferred from the female into the specialized organ of the male, where they are incubated and the young remain for some time after hatching.<sup>3</sup> It seems that when nature created the seahorse it was determined to do a good job and concentrated all sorts of oddities in this little creature. Here is a fish the head of which resembles that of a horse; with a hard-jointed external skeleton resembling that of an insect; with a prehensile tail like a monkey's; and with a pouch on its underside for carrying its young after the fashion of a kangaroo, but the male instead of the female acts as an incubator and carries the young.

Notwithstanding the wide popular and scientific interest that these truly fascinating living things have attracted, it is remarkable, and in a measure symptomatic of the state of taxonomy of fishes in general, how much misapprehension exists in regard to the proper distinction of the separate species, as the data presented here will amply prove. To show the existing chaotic state in the systematics of *Hippocampus*, the genus of seahorses, some of the results of my study may be considered here briefly.

This investigation was undertaken chiefly to evolve satisfactory characters for separating the species found on the Atlantic and Pacific coasts of North and South America and to establish definitely the intraspecific ranges of variation. It was found desirable to include also the species from the coasts of Europe, since they are very closely related to the common American species, and there was some question as to whether they are really distinct. It has also been necessary to establish five new species, which were briefly described in a preliminary paper,<sup>4</sup> and one new subspecies, described herein. Furthermore, five more or less recent names proposed for seahorses from American waters had to be reduced to synonymy. The appropriateness of the synonymic reduction of one or two of these names may be open to question until their types are reexamined, but their authors certainly did not prove the distinctness of the supposedly new species.

A suggestive case of the existing errors in the systematics of *Hippocampus* may be cited here. According to the generally accepted

<sup>3</sup> For a review of the known facts in the biology of the seahorse, see Gill, Proc. U. S. Nat. Mus., vol. 28, pp. 805-814, 1905; and Rauter, Syngnathiden des Golfes von Neapel, 1925.

<sup>4</sup> Journ. Washington Acad. Sci., vol. 23, pp. 560-563, 1933.

"belief", three more or less common and large species exist on the Atlantic coast of the United States, namely, *H. hudsonius*, *H. punctulatus*, and *H. styliifer*, which allegedly may be distinguished largely by the number of rays in the dorsal fin, *hudsonius* having the most rays and *styliifer* the least. It will be shown definitely hereafter that *styliifer* is a fictitious species based originally on a young female of *punctulatus*, while *hudsonius* and *punctulatus* are merely geographical subspecies that intergrade to a high degree; and, moreover, that *hudsonius* is the one averaging the fewest dorsal rays.

The student will find similarly striking cases in the text, but for benefit of readers who do not wish to delve too deeply into the systematics of *Hippocampus*, one more interesting illustration may here be cited. Nearly all authors correctly distinguished two common species of seahorses, *hippocampus* (*brevirostris* of most authors) and *guttulatus*, from the Mediterranean coast of Europe. These two species are readily separable, as is shown hereafter. However, the systematics of the seahorses on the Atlantic coast of Europe are generally muddled. An inclusive, though probably incomplete, review of the literature shows that the consensus of opinion among authors is that only one species of seahorse exists on the Atlantic coast of Europe. This allegedly single species has been referred now to one now to the other of the two common Mediterranean species, depending on the author. This treatment is evidently not in accordance with the facts. My study indicates, if the stated localities of the lots examined are correct, that at least two species of seahorses exist on the Atlantic as well as on the Mediterranean coast of Europe, but the two Atlantic species are not so readily separable as the Mediterranean ones. One of the Atlantic coast species is closely related to but distinct specifically from *hippocampus* and is designated hereafter as *europaeus*. The other Atlantic seahorse is apparently conspecific with *guttulatus* from the Mediterranean, but the Atlantic coast population diverges sufficiently to be regarded as subspecifically distinct from the Mediterranean population, and is designated herein as *multiannularis*. Since, however, part of the European seahorses in American museums that were available for examination are in indifferent condition and the locality records of some of the lots are uncertain, the conclusions regarding the European species arrived at may have to be modified after an examination of larger numbers of specimens in good condition and with definite locality records. However, my study and a review of the literature showed without doubt that the current systematic treatment of the seahorses found on the Atlantic coast of Europe is largely erroneous.

The confusion in the systematics of *Hippocampus* is shown even more strikingly by the obvious and frequent misapplication of names

in published records. This is true not only of sporadic and occasional records, as in local lists of fishes, but also of accounts of the entire genus. Three such accounts have been published, namely, by Kaup,<sup>5</sup> by Duméril,<sup>6</sup> and by Günther.<sup>7</sup> After one becomes familiar with the true distinctive specific characters and the geographical distribution of the species, it is only necessary to skim through the accounts of these authors to see how badly in some cases they mixed up their species.<sup>8</sup>

On account of existing errors it seemed useless, or even misleading in some cases, to attempt a compilation of complete bibliographies of the species concerned to indicate their geographic distribution. Consequently, the bibliographic citations given here under each species include only: (1) Primary synonyms; (2) references having a direct bearing on the nomenclature; (3) readily available records based on material examined by me; and (4) a few records that may be referred to their proper species with some assurance. The precise geographical limits of nearly all the species or subspecies still remain to be determined.

#### ACKNOWLEDGMENTS

I wish to express grateful acknowledgment for aid rendered in this investigation, which is based largely on the comparatively extensive collection of seahorses in the United States National Museum. Dr. Alexander Wetmore and Dr. Leonhard Stejneger kindly permitted my access to the facilities and collections of the Museum, and Earl D. Reid unstintedly gave his time to make available these collections. Special acknowledgment is due Dr. George S. Myers, who took his post as assistant curator of fishes in the National Museum while this study was in progress. Besides making some constructive suggestions and calling my attention to some obscure publications, Dr. Myers, in putting in order the mass of accumulated miscellaneous unclassified material in the National Museum, uncovered and placed at my disposal many desirable specimens, which

<sup>5</sup> Catalogue of the lophobranchiate fish in the collection of the British Museum, 1856.

<sup>6</sup> Histoire naturelle des poissons ou ichthyologie générale, vol. 2, 1870.

<sup>7</sup> Catalogue of the fishes of the British Museum, vol. 8, 1870.

<sup>8</sup> Such treatment of *Hippocampus* has continued until our day. In a work on the fishes of West Africa by H. W. Fowler (Bull. Amer. Mus. Nat. Hist., vol. 70, 1936), which appeared after the completion of the manuscript of this report, the author makes the statement that he cannot "find any characters worthy of specific distinction" between *H. hudsonius* and *H. hippocampus*, and at the same time he recognizes *H. punctulatus* as a fully distinct species. As a matter of fact, *punctulatus* is nothing more than a geographic subspecies of *hudsonius*, while *hudsonius* and *hippocampus* are as fully distinct and divergent as almost any other two species of the subgenus *Hippocampus*. If those two species were synonymized, it would be necessary, in order to be consistent, to lump all species of the subgenus *Hippocampus* in one species. Such a taxonomic absurdity was not suggested for more than a century by any writer that I know of, and it is evidently not subscribed to by Fowler. His descriptions were apparently made in haste, and it is hard to surmise the species he had; but judged by the dorsal count he gives under *hippocampus*, it seems apparent that his account of that "species", based on Mediterranean material, includes specimens of both common species occurring in the northern part of that sea, *hippocampus* and *guttulatus*. His account of *punctulatus* undoubtedly is also based on material of more than one species, judged by the geographical distribution of the species of *Hippocampus* in general.

aided materially in bringing this study to a point more nearly approaching completeness. For material lent by other institutions acknowledgment is due the following: Dr. Carl L. Hubbs, who lent two lots of seahorses from the Zoology Museum of the University of Michigan, one of these lots forming the basis of a new subspecies, *multiannularis*; Alfred C. Weed, who lent the desirable collection of *Hippocampus* in the Field Museum of Natural History, which helped me considerably in distinguishing *kincaidi* and in confirming my conclusions in regard to some other species and subspecies; John T. Nichols, who lent seven specimens of *H. hippocampus* from the collection of the American Museum of Natural History, which were of considerable help in distinguishing that species from closely related ones.

Particular mention is made of the work of Miss Louella E. Cable, who executed with skill and painstaking care the drawings for the figures, which should prove invaluable in the identification of specimens. Whatever merit this report may prove to have, it will be greatly enhanced by these beautiful and accurate illustrations.

#### DEFINITIONS AND METHODS OF STUDY<sup>9</sup>

The proper differentiation of the species of *Hippocampus* is difficult at best. This difficulty is greatly increased by the lack of uniformity in descriptions of the species by various authors. It becomes necessary, therefore, to explain the methods of study and define the terms used.

*How to determine accurately the number of trunk segments.*—The first important point to decide is a uniform method in the determination of the boundary line between the trunk and the tail, since the number of segments in the trunk and to a lesser extent that of the tail form specific characters of primary importance. The distinction between trunk and tail is readily made after the integument is removed and the exoskeleton uncovered (fig. 54). This is, of course, impracticable when identifying specimens. Externally the last trunk segment is readily determined by the fact that the ventrolateral ridge of the trunk extends only to that segment. The last spur on that ridge, or, where the spur is missing, the last intersection of the longitudinal with the transverse ridge on the side, unmistakably marks the last trunk segment. From that intersection a winglike extension converges with its fellow from the other side to the base of the anal for the support of that fin, but this extension is usually covered by thick integument and not visible externally. In practice the best way to count the trunk segments with absolute accuracy is to trace the transverse ridge on the last segment from its lower point, as de-

<sup>9</sup> The reader will find it advantageous to study figure 54 in connection with the discussion here of the structure of some parts of the exoskeleton, which are of importance in classification.

terminated above, to the spur under the base of the dorsal fin, and count the spurs or spines on the upper ridge, forward. Where the spurs or spines fade out anteriorly, the transverse ridges on the back of the segments in front of the dorsal fin always saliently mark their segments.

What appears on external examination to be the first trunk segment, the one bearing the pectoral, is a compound segment and is composed of three metameres, corresponding to the first three vertebrae, according to Rauther.<sup>10</sup> The posterior one of these three metameres is readily identified by having a spur on the upper longitudinal ridge and a transverse ridge on the back, as in the following segments. It was consequently included in the counts recorded in this study. The more or less reduced elements of the anterior two metameres are intimately fused with the third, and the three appear externally as a single somewhat irregular segment, bearing the pectoral fin. This compound segment was uniformly counted as one throughout this study, by including the spur or ridge of the third metamere with the following ones, as stated. The anterior two metameres were not included separately in the count, although their presence usually may be detected externally by the two nuchal, more or less spurred, plates. (The coronet may possibly represent a remnant of still another primitive metamere.)

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FIGURE 54.—EXOSKELETON OF HIPPOCAMPUS HIPPOCAMPUS (AFTER RAUTHER)

*cor.*: Coronet.

*nu. pl.*: Nuchal plate. The two nuchal plates on the mid-dorsal surface form parts of the reduced anterior two segments, corresponding to the first two vertebrae, according to Rauther. These two segments are intimately fused with the third. All three appear externally as one irregular segment, bearing the pectoral fin, and were counted as one in this study.

*tr. seg. 1*: The first trunk segment as arbitrarily and uniformly adopted for the purpose of this study.

*anlp. tr. seg.*: Antepenultimate trunk segment, showing the typical structure of a trunk segment as follows:  
*up. pl.*, upper plate; *med. pl.*, median plate; *l. l. pl.*, lower lateral plate; *m. v. pl.*, midventral plate.  
 The first three plates are paired and the last is unpaired, a typical trunk segment thus being septangular in cross section.

*p. tr. seg.*: Penultimate trunk segment. Note that this segment is septangular like the preceding, except that the upper plate is pushed upward to occupy a position nearly in a line with the extra plates on the following two segments. The penultimate trunk segment sometimes also has an extra plate and is novemangular, depending on the species or on individual variation.

*l. tr. seg.*: Last trunk segment. This segment lacks the midventral plate and has an extra plate, *ex. pl.*, superimposed over that plate, which is the homologue of the upper plates of the preceding segments. This segment is always octangular, except in *zosteræ*, where it is often hexangular, and sometimes asymmetrical in other species as an infrequent individual variation.

*caud. seg. 1*: First caudal segment. This is like the following segments except that it has an extra plate on top, and is thus hexangular. The absence of an extra plate on this segment is usually a specific character, sometimes an individual variation.

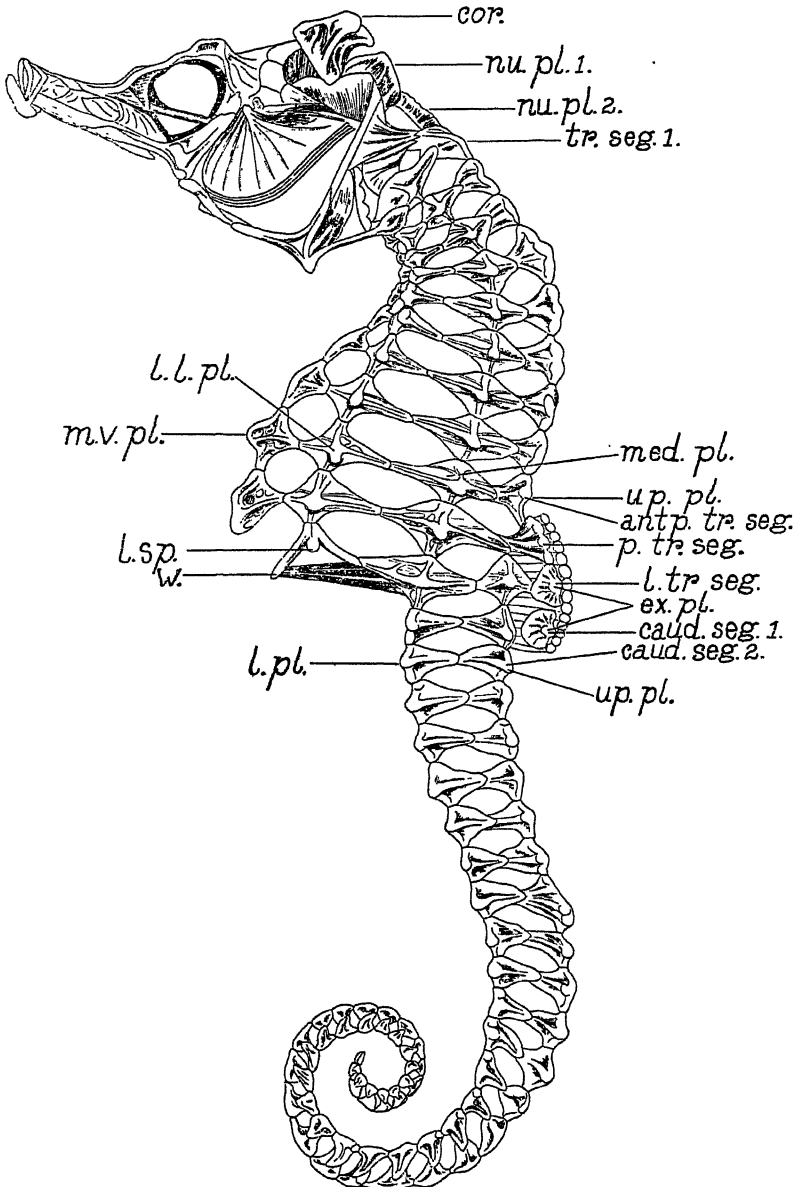
*caud. seg. 2*: Second caudal segment, showing *up. pl.*, upper plate, and *l. pl.*, lower plate; both are paired, and a typical caudal segment is quadrangular.

*l. sp.*: Last spur on lower lateral ridge, unmistakably marking the last trunk segment externally and nearly always present, except in occasional specimens having the last trunk segment asymmetrical; sometimes obsolescent.

*w.*: Wing from lower plate of last trunk segment extending inwardly to meet its fellow from the opposite side behind the anal fin.

<sup>10</sup> Die Syngnathiden des Golfes von Neapel. Fauna und Flora des Golfes von Neapel, Monog. 36, 1925.

As far as I can judge by current descriptions of seahorses, authors generally count the first compound segment as one; but some writers apparently include the first caudal segment in the count of the trunk segments, although nearly all accounts are not clear regarding the method of counting used by their authors. Where authors definitely



[See opposite page for description]



include the first caudal segment and count the first compound segment as one, the given count of the trunk segments should be reduced by one to make it comparable with the uniform method adopted herein.

In occasional specimens the last trunk segment is incomplete, or it would perhaps be more correct to state that it is asymmetrical, since the ventrolateral ridge extends to that segment on one side only, that ridge ending on the preceding segment on the opposite side. Consequently, the counts on the opposite sides will differ by one, if the method of counting outlined here is followed. In such cases the incomplete last segment is uniformly included in the count, and the number of such variant specimens is listed in parentheses in the diagnoses.

There is one possible important source of error in counting the segments of the trunk as well as those of the tail. The transverse ridge lies along the center of the segment and does not form the boundary between two segments. The natural impulse is to take the space between two transverse ridges to represent a "ring" or segment, but when this method is followed the trunk may erroneously be determined to have one segment less than the actual number.

*How to determine the number of caudal segments.*—The first caudal segment differs in shape with the species. In most species it has three spurs or points of intersection of transverse and longitudinal ridges, and thus appears to be hexangular in cross sections, except as an infrequent individual variation, while the following segments are quadrangular. In one species nearly always, and in the majority of specimens of another species, the first caudal segment appears to be quadrangular in cross section like the following segments. Bearing this difference in mind, one may determine accurately the number of segments in the anterior part of the tail by counting the spurs on the upper ridge, as in the case of the trunk. However, since the spurs and ridges fade out more or less in the posterior part of the tail, an accurate count of the entire number of tail segments by this method is impossible. The method finally adopted for practical purposes depends on a peculiarity of preserved specimens—a comparatively deep transverse groove usually present on the ventral side, marking the boundary between two segments. The posterior tail segments, therefore, are determined most readily by counting the spaces between the transverse grooves on the lower surface, starting with the last segment and counting forward. The last two segments sometimes have no groove between them, especially in the small species, and should be examined with care. If what appears to be the last segment is considerably longer than the preceding one, it most likely consists of two segments; but if subequal to, or shorter than, the preceding, it is most likely a single segment. This may be checked by

flexing upward the end of the tail with the tip of a dissecting needle. It is possible that if the fish were macerated and the last one or two segments determined with absolute accuracy, the numbers would differ slightly from those given in this report. However, this is manifestly impracticable, and the difference, if any, would be very slight. In employing the method of counting here described, one should also note that there is sometimes a transverse groove on the *center* of many tail segments on the ventral side. Although sometimes confusing, this groove is nearly always much shallower than the one marking the boundary between the segments, and with a little practice the distinction between the two sorts of grooves is readily made. The grooves often disappear in the anterior part of the tail, but the transverse ridges and spines, at the center of the segments, become prominent anteriorly and aid in the accurate determination of the number of anterior segments. Where the grooves on the ventral side are indistinct, the tail may be uncoiled and its lower side placed against a glass slide. The pressure of the slide against the natural tendency of the tail to recoil brings out the boundaries between the segments on the dorsal side with more or less prominence, and they may thus be counted on that side.

*Modification in structure of segments in region between trunk and tail.*—Special attention should be called here to some structural characters of the species of *Hippocampus* that hitherto have received only scant attention but that are of considerable importance in the proper differentiation of the species in showing their probable relationship and in distinguishing the subgenera. I have reference to the modification in the structure of the first caudal and last trunk segment; sometimes the last two trunk segments are involved. The modification of the first caudal segment was briefly referred to in the preceding paragraph in connection with the accurate determination of the number of caudal segments. The modified nature of all the segments in that region will now be discussed in greater detail.

We are concerned herein chiefly with the external structure of the fish as seen without any dissection, for the practical purpose of distinguishing the species. For a detailed description of the minute structure of the segments, the reader is referred to Rauther<sup>11</sup> or to Duncker.<sup>12</sup> However, the gross external structure may be better understood when the detailed anatomy is considered. Briefly, a typical caudal segment consists of four plates, two dorsolateral and two ventrolateral. Each plate consists of two wings bent at an angle with a lengthwise ridge along the bend. Another, a transverse and blunter ridge, occurs along the middle of the plate. When joined the four plates somewhat overlap, are loosely ankylosed by projecting

<sup>11</sup> Die Syngnathiden des Golfes von Neapel, pp. 68-74, pl. 7, 1925.

<sup>12</sup> Syngnathiden-Studien. Mitth. Naturh. Mus. Hamburg, vol. 25, pp. 18-20, 1908.

irregularities of surface, and are tied together by connective tissue and the skin and thus form a segment. The plates of each segment also overlap with those of the adjacent segments to form one continuous ridged exoskeleton. A typical tail segment is thus quadrangular. A typical trunk segment, in addition to the four plates just described, has an irregularly oblong or elongate plate interpolated on the side between the dorsolateral and ventrolateral plates, and another, unpaired, roughly trough-shaped plate is interpolated between the two ventrolateral plates. The midventral plate is absent on the last trunk segment. The longitudinal ridges on the series of interpolated plates on the side form the lateral ridge of the trunk, while the series of troughlike plates forms the midventral ridge. The trunk thus typically has three ridges on each side and one midventral ridge, the latter extending only to the penultimate segment. A typical trunk segment is thus septangular.

The fact that the midventral ridge does not extend to the last trunk segment causes that segment to assume a different shape from the preceding one, but the chief cause of the modifications of the segments in the region where the tail and trunk meet is the structure of the base of the dorsal fin, which is on a more or less raised platform. The elevation is caused partly by one or more extra plates present there, forming a support for the dorsal. The number of extra plates and their positions differ with the species. The presence of these plates results in certain changes in the external appearance of that region, which are next described.

As already noted, a typical caudal segment is quadrangular. In most species the first caudal segment normally has an extra plate and is thus hexangular, with few individual variants; in one species, *regulus*, the first caudal segment nearly always lacks the extra plate and is normally quadrangular like the following segments; while in another species, *zosteræ*, it is usually quadrangular but often hexangular, the frequency of the hexangulate condition depending on the local population of that species.

The last trunk segment nearly always bears an extra plate on top for the support of the dorsal in the species described here, and this, together with the lack of the midventral ridge, causes it to be normally octangular, with one exception, *zosteræ*, in which it often lacks the extra plate and is then hexangular. The penultimate trunk segment usually lacks an extra plate, but it has a midventral ridge and is consequently normally septangular, like the segments preceding it. Sometimes, however, it has an extra plate and is then novemangular. The novemangular penultimate trunk segment is present as an individual variation with greater or lesser frequency in nearly all the species examined, becomes nearly the dominant condition in *ingens*, and is normal in the subgenus *Macleayina*.

Besides the difference in the number of angles, the extra plates to a pronounced extent also cause another effect, namely, the relation between the upper ridge of the tail and that of the trunk. The extra plates occupy a position above the upper plates of the tail segments. The longitudinal ridge formed by the extra plates is, however, continuous or nearly so with the upper ridge of the trunk. This effect is caused by one or two of the upper plates of the trunk being pushed upward to form a continuous ridge with the extra plates. For instance, if the extra plates are present on the first caudal and last trunk segments—this being the usual condition in the subgenus *Hippocampus*—the penultimate trunk segment has the position of the upper plate raised to form a nearly continuous ridge with that of the extra plates. On account of the presence of extra plates, the upper ridge of the trunks is raised sharply above and overlaps that of the tail. The tail ridge is continuous, or very nearly so, with that ridge on the last one or two trunk segments, which is immediately below the ridge formed by the extra plates. Consequently, the number of segments on which the two ridges overlap corresponds to the number of extra plates under the base of the dorsal.

It is now evident that the modification of the structure may be described in three different ways: (1) By the number of angles in each of the modified segments; (2) by the number of segments on which the two upper ridges overlap and the position of those segments; and (3) by the number of extra plates and their position. No matter what form of descriptive statement is chosen, it is to be remembered that it refers to the same fundamental structure, namely, the presence of extra plates, their number, and position. In the diagnoses that follow under each species, the variation is described first with reference to the number of angles in each modified segment, and statements are added in regard to the extra plates and the overlap of the upper ridges of the tail and trunk. All three forms of the statement, however, refer to the same fundamental structure, which is of considerable importance in classification.

Sometimes, as an individual variation, a segment may have an extra plate on top on one side only. For instance, in a species in which the first caudal segment is normally hexangular, an individual fish may lack the extra plate on one side only. Such a segment is hereafter designated as *incompletely* hexangular, octangular, or novemangular, as the case may be. While such a designation, literally speaking, is incorrect, it yet describes the fundamental condition and variation of the structure.

*Proportional measurements.*—The adoption of a uniform system in taking some of the measurements is especially important in the seahorses, since these fishes assume an infinite variety of forms, on account of the flexibility of the tail and the "throat" region. In

taking the measurements for this study, the tail was straightened by pressure. When the tail was much coiled and contracted it was sometimes necessary to exert considerable force to straighten and hold it in place. No attempt was made to straighten the trunk. The head was bent either upward or downward, as necessary, until its lower profile assumed a position perpendicular to the tail. With the fish held in this position, the **length** is taken to be the distance from the tip of the tail to the tip of the coronet; the **tail** is the distance between its tip to the median, lateral point on the boundary between the last trunk and the first tail segment, as defined above; while the **trunk** is the distance from the latter point to the upper margin of the gill opening. The **depth** is that of the deepest segment, usually the one on which the origin of the dorsal is situated, or the one immediately before or behind, this being in front of the brood pouch, and consequently the measurement of males having that structure much developed is fairly comparable with all other specimens. The depth is taken between the lowest points on the upper and the midventral ridge, the spines not included. The **head** is measured from the tip of the snout to the dorsal margin of the gill opening; the **postorbital** from the latter point to the posterior margin of the orbit; the **snout** from its anterior margin, on the midline, to the anterior margin of the orbit; the **orbit** between opposite points on its bony margin which is usually indicated as a slight keel but often quite indistinct (this measurement, therefore, is not susceptible of a high degree of accuracy). Since the fish is more or less contractible or distensible along its longitudinal axis, the length of the tail, the trunk, and the total length used as a standard of comparison will vary somewhat with the state of the specimen at the time of its preservation, and also with the state of preservation. This inaccuracy is inherent in the subject matter and cannot be avoided. However, if the same method is followed throughout, the figures are comparable, especially if they are based on numbers of specimens. All measurements are expressed as a percentage of the length.

The methods of counting the segments and taking the measurements are explained in detail, because it is absolutely essential to follow a uniform system; otherwise descriptions of seahorses are not of much value in the identification and distinction of the species. For instance, the trunk segments in a given species may be recorded either as 11 or 12, depending on the method of counting, as noted. Since the predominant difference of one segment is usually a good specific character, the necessity for care and uniformity of method is evident. All measurements recorded here were made with a vernier caliper.

In taking measurements, and also in counting the caudal segments, it is important to note whether the tail is broken off at the tip. Sometimes one or more caudal segments have been broken off at the tip. Usually a broken tail may be discerned readily, but in infrequent cases it has been almost perfectly regenerated and may be detected only by close scrutiny, by the unnatural stumpy appearance of the tip of the tail. In such cases proportional measurements, with the length used as the standard, are evidently of no value or may be even misleading. Consequently, measurements and the caudal segment count of such specimens have been omitted from the data here presented.

*Fin rays.*—An absolutely accurate count of rays in the dorsal and pectoral fins is essential, but this count is not likely to vary with different observers. Sometimes the last two, and less often the first two, dorsal rays are closely approximated. For this study such rays were enumerated separately. The pectoral rays were always enumerated on the right side, unless the fin was broken on that side, and no account was taken of any occasional probable differences in the numbers of both sides.

#### DIFFERENCES DUE TO SEX AND AGE

In studying seahorses it is very important to take account of the size and sex of the specimens, especially when one attempts to establish a new species. In general, younger fish of either sex differ from older individuals in having better-developed tubercles or spines, a higher coronet, a longer snout, and a slenderer trunk. The tail is somewhat shorter and the trunk longer, but these two differences are not so well marked as the preceding ones. The females differ from the males in the same way as the young of either sex differ from grown specimens, but the differences between the sexes are generally not so pronounced as those due to size. A study of tables 2 and 3 (pp. 531–533) shows these differences to hold, except in a few cases possibly due to the small number of specimens measured, in consequence of which extreme variants are likely to have a greater effect on the averages. The exceptions may also be due to the sexes not having been completely separated, as hereafter discussed, or to the inherent difficulty of taking very accurate measurements of seahorses.

Three of these differences—the relative development of the tubercles, the length of the snout, and the depth of the trunk—are also of importance in separating some of the species. It is evident, therefore, that size especially must be considered when identifying and distinguishing seahorses. It is also of considerable, though lesser, importance to compare specimens of the same sex.

The sexes may be distinguished in most species by the presence of a brood pouch in the male. Young males have at least the rudiments of a brood pouch indicated by an elliptical fold of skin or sometimes by an elliptical pigmented area on the underside of the anterior caudal segments, later developing into a brood pouch. The rudimentary brood pouch appears when the fish is quite small, the size probably depending on the species, at about 40 mm in *hudsonius*.

The brood-pouch criterion was used to separate the sexes and segregate the measurements presented in tables 2 and 3. This sex distinction does not always hold, since Rauther<sup>13</sup> found that the majority of the females of *brevirostris* (= *hippocampus*) and a fair percentage of the females of *guttulatus* also have the brood pouch developed, at least in rudimentary form. The sex in *europaesus* as well probably cannot be distinguished readily by the development of the brood pouch (see p. 550). It yet remains to be determined to what extent, if any, this condition occurs in other species. On account of the failure of this criterion to distinguish the sexes in all cases, it would have been desirable to separate the sexes more definitely by a histological examination of the gonads. However, by a close inspection of my rough data, I concluded that the probable greater accuracy to be attained by such an examination would result merely in showing a somewhat greater divergence or, in most cases, a lesser degree of intergradation of average differences. It seems evident also that no absolute distinction between the sexes may be made on the basis of proportional measurements. Since the available material, when sorted according to sex, size, and locality, is not sufficient for satisfactory statistical studies anyway, it was not deemed expedient to spend more time on histological studies of the gonads for the mere purpose of showing more accurately the average differences between the sexes, or drawing more finely the lines of distinction between the species.

It is significant that in nearly every species in which a fair number of specimens were examined the largest individual had a brood pouch. This would indicate that in seahorses the male attains the larger size.<sup>14</sup>

#### FILAMENTS AND OTHER APPENDAGES OF THE SKIN

The use of the presence or absence of filaments in specimens of seahorses as a character in classification has caused considerable confusion in the systematics of *Hippocampus* and has resulted in some unnecessary synonyms.

Specimens of seahorses are found now and then that have a profusion of long and branched filaments (see fig. 64). This character

<sup>13</sup> Die Syngnathiden des Golfes von Neapel, pp. 212-213, 1925.

<sup>14</sup> Gill, Proc. U. S. Nat. Mus., vol. 28, p. 809, 1905, states that the male is somewhat smaller than the female.

gives them such a striking appearance that it is hard to conceive of it as not being of importance in classification. Some species, indeed, have been based in large part on this character, as *ramulosus* (p. 518) and *kincaidi* (p. 569). My study has shown unmistakably, however, that among seahorses this character is largely due to individual variation, a conclusion to which other investigators arrived at previously (see p. 518 for definite examples cited). To some extent it is an age character—that is, filaments are oftener present in the smaller size groups, at least in the specimens examined; but in either young or full-grown specimens they may be indiscriminately present or absent. To a certain limited extent it possibly is a species character in the sense that in some species specimens with filaments or with a profusion of filaments apparently are oftener present, while in other species specimens with filaments are comparatively infrequent or the number of filaments, when present, is few. However, this slight specific difference may be discerned only after the species have been separated by other means. Taken by itself this character is of little value in classification. Indeed, in the manner in which it has been used, it has had a rather negative value.

In the species I examined, filaments on the tubercles as an individual variation were found in all except *H. europaeus*, but the eight available specimens of this species are in indifferent condition. In *hildebrandi* and *obtusius* there are a few short chunky appendages instead of slender filaments, and such appendages were observed in occasional specimens of other species also. As a result of my studies of the seahorses and a consideration of descriptions and figures in the literature, it is evident that the presence or absence of filaments or other appendages on the tubercles is highly variable. They are probably present in all or nearly all the species, in some specimens at least.

In addition to the filaments or fleshy appendages on the tubercles, seahorses are often found with pimplelike excrescences scattered over the skin, or with many very short filaments on the surface of the skin. These structures apparently also differ with age, with the individual, and to a limited extent with the species, in the same manner as do the filaments on the tubercles. The apparent development of these small excrescences probably depends also on the state of preservation of the specimens. (See further discussion under the account of *hudsonius*, p. 555.)

#### GEOGRAPHICAL DISTRIBUTION

In regard to the geographical distribution of the seahorses, Günther<sup>15</sup> makes the following statement: "They are pelagic fishes which

<sup>15</sup> Catalogue of the fishes of the British Museum, vol. 8, p. 198, 1870.



attach themselves to seaweed or other floating substances, and are liable to be carried by currents to great distances. Consequently, some species are spread over different parts of the globe, like *Antennarius*, a genus the geographical distribution of which nearly coincides with that of *Hippocampus*." Though this may be true of the geographical distribution of *Antennarius* or some of the species of *Hippocampus*, it certainly does not apply to some of the species discussed herein. On the contrary, two species of which a fair amount of material is available, *hudsonius* and *zosteræ*, are shown here to tend to break up into distinct populations, which may be separated by the ordinary statistical methods. These stocks are found to occupy rather circumscribed geographical areas. Thus, the populations of the subspecies *hudsonius* from Chesapeake Bay and northward, from North and South Carolina, and from Mississippi to Texas show average and statistically measurable differences. This is also true regarding the populations of *zosteræ* from Pensacola, Captiva Pass, and Key West. (This subject is discussed at greater length under the respective species.) The tendency to break up into distinct stocks within comparatively circumscribed geographical areas is evidently a necessary consequence of the relative immobility of the seahorse, which is a very feeble swimmer and probably spends its life attached to seaweed in the vicinity where it was hatched. Specimens of various species are sometimes pelagic and are often taken in surface towings, but such definitely pelagic specimens as I came across were immature or sexually undeveloped (p. 556). In view of the fairly distinctive character of populations inhabiting certain regions within the range of their species, it seems evident that the few pelagic specimens that may be carried outside of their range by waves and currents are not able to establish themselves, grow to maturity, and reproduce in the region of their immigration. To the erroneous idea in regard to the geographical distribution of seahorses evidently is to be ascribed, in part, the chaotic state in which the systematics of *Hippocampus* is now found. Because of the failure of authors in many cases to distinguish their specimens properly, the geographical distribution of species and subspecies is mostly unknown. The geographical range, as far as known or as indicated by material examined, is presented under each species or subspecies.

#### UNCERTAIN SPECIMENS

In an extensive study of variation among the species comprising a genus, some extreme variants may be found that cannot be referred to their proper species with certainty. While such specimens usually are comparatively few, they are of extreme interest and importance.

In a way they offer a challenge to the correctness of the author's conclusions. In view of the variability shown by the species and subspecies of seahorses, their near approach to one another, and their frequent overlapping, it is no wonder that there are some uncertain specimens. What is more surprising is that they proved to be comparatively few. Full-grown or nearly full-grown seahorses usually have a typical structure, color, or appearance, which in combination with the correlation of the counts and measurements of the specific characters makes it possible, with a fair degree of assurance, to refer the bulk of them to their proper species even without a previous knowledge of the locality of capture. The identification of the rest of the specimens, those that are not entirely typical, is aided by a knowledge of the locality of capture, after the known geographical distribution of the species and subspecies is taken into account. In the present study there were only three specimens of which the identification was doubtful. Each one of these is discussed separately after the account of the species or subspecies to which it is referred (pp. 542, 546, and 572).

#### NOMENCLATURE

There is an utter state of chaos in the literature in regard to the use of names for some very common species of seahorses in various parts of the world. This confusion, aside from the difficulty of distinguishing the species, may be traced in a large measure to Cuvier's introduction of three new names for seahorses without giving adequate accounts, having based those names largely on some crude figures previously published by Willughby; and, more particularly, to Cuvier's as well as later authors' neglect of previous binomial writers. Another fruitful source of confusion is that the first binomial name used by Linnaeus for seahorses was evidently applied to a composite of more than one species. In order to fix firmly the nomenclature of the species with which this report is concerned, a review of the pertinent literature is given. Since the nomenclatorial status of more than one species sometimes depends on a consideration of the same publications, the discussion is given here together for the several species, and the conclusions arrived at as a result of the review are pointed out again under each species concerned. Only works having a direct bearing on the nomenclature are discussed in chronological order.

Linnaeus<sup>16</sup> described a species of seahorse, naming it *Syngnathus hippocampus*. The work in which it was described is the starting point of zoological nomenclature, according to the International Code, and his name must be used for some species, if identifiable

<sup>16</sup> *Systema naturae*, ed. 10, p. 338, 1758.

at all. The question is, which species? Linnaeus' description of *S. hippocampus* is as follows: "Pinna caudae nulla, corpore septemangulato tuberculato, cauda quadrangulata. D. 20. P. 18. . . . Art. gen. 1 syn. 1. Syngnathus corpore quadrangulo, pinna caudae carens. D. 35 . . . Habitat in Pelago. *Laminae corporis trunci* 17, *caudae* 45."

This account is largely generic and undoubtedly includes more than one species, since some of the characters belong to widely separated and unrelated species. For instance, no species of seahorse now known has a combination of 20 dorsal rays and 45 caudal segments, although each one of those counts may be present in one species or another. Evidently Linnaeus intended to include all seahorses in one species. At any rate his description, including the given locality, applies to more than one species. Consequently, on the basis of the original account, *Syngnathus hippocampus* Linnaeus represents a composite of more than one species, and it remains to be seen how later authors restricted the use of the specific name *hippocampus*.

Binomial authors immediately following Linnaeus generally continued to treat the seahorses as a single species. What is probably the best of these earlier accounts is that of Bloch<sup>17</sup> under the name of *Syngnathus hippocampus*. His figure shows a long snout and the spines on the trunk and tail well developed and is a fairly good representation of the common long-snouted Mediterranean seahorse, the species later named *H. guttulatus* by Cuvier. Of the three common European species the figure would apply more nearly to that species. Also, at least part of Bloch's material evidently came from the Mediterranean. However, Bloch cannot be said to have restricted the use of the specific name *hippocampus*, as is indicated by his statement:

"\* \* \* Dieser Fisch wird häufig an den Ufern des Mittelländischen Meeres, besonders zu Pozzuli, Neapel, in Frankreich bei Marseille, im Nordmeere, und in Indien in der Strasse Sunda angetroffen \* \* \*. Ray, der aus demselben unrichtig vier besondere Gattungen gemacht, hat unstreitig den Klein verleitet, drei Nebengattungen anzunehmen: den die Fasern, die etwas mehr hervorstehenden Höcker und die tiefern Einschnitte zwischen den Schildern sind nur Zufälle, die vom Alter, oder der Verschiedenheit des Geschlechts herrühren."

While the variable characters enumerated by Bloch depend, as he stated, on sex and age, they also differ with the species. At any rate, his remarks as quoted, as well as the geographical distribution he gives, clearly show that he regarded all seahorses as belonging to one species.

<sup>17</sup> Naturgeschichte der ausländischen Fische, pt. 1, p. 7, pl. 109, fig. 2, 1786. The quotation here is from the 8vo. ed.

The next writer we have to consider is Rafinesque,<sup>18</sup> whose account is as follows:

"XIX G. Hippocampus—Un ala dorsale, un ala anale, nessuna caudale.—Oss. Il curioso *Syngnathus hippocampus* compone questo genere insieme col *S. tetragonus* in opposizione del quale lo chamero *H. heptagonus*."

Having established the genus *Hippocampus*, he substituted the name *H. heptagonus* for *S. hippocampus*, and this species is the type of his genus by tautonymy. The *S. tetragonus* he mentions is evidently Gmelin's species, which is now regarded as a synonym of *Syngnathoides* or *Gastrotekeus biaculeatus* (Bloch).<sup>19</sup> In regard to Rafinesque's restriction of the specific name *hippocampus*, two interpretations are possible: (1) Having listed the Sicilian seahorses as *H. heptagonus*, he restricted the specific name *hippocampus* for which it was a substitute to a Mediterranean species; or (2) like his predecessors he regarded the seahorses proper, the fishes now generally placed in the genus *Hippocampus*, as belonging to one species and did not in any way restrict the use of the specific name *hippocampus*. Since Rafinesque does not give an adequate account of the species, this question remains unanswered. To settle the problem of nomenclature, however, this question need not be answered, since Leach a little later more definitely restricted the specific name *hippocampus* to a Mediterranean species.

Another author whose work appeared in the same year as that of Rafinesque and has a bearing on the nomenclature of the seahorses is George Perry.<sup>20</sup> This work was neglected by subsequent writers, although it is superior to some publications that appeared contemporaneously. An account of it is given by Gregory M. Mathews and Tom Iredale,<sup>21</sup> who list four extant copies known to them. According to them, Perry's *Arcana* was issued serially as a monthly periodical, and the separate numbers were bound together in book form having a common title page, dated 1811. The library of the United States National Museum has an incomplete copy, which I examined; it has a written copy, but not the original, of the title page. It consists of colored plates and descriptive matter without any page or plate numbers, but the plates bear dates.

Two places in Perry's *Arcana* are to be considered in connection with the nomenclature of *Hippocampus*. The first is a plate dated May 1, 1810. The accompanying letter press is headed: "*Genus*—*Syngnathus*, or *Hippocampus/Species*—*Foliatus*." The heading is followed by an account of a single species, which is apparently the same as the

<sup>18</sup> Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, p. 18, 1810.

<sup>19</sup> See Weber and Beaufort, The fishes of the Indo-Australian Archipelago, vol. 4, p. 39, 1922.

<sup>20</sup> *Arcana*; or The museum of natural history . . . , 1810. I am indebted to Dr. George S. Myers and Austin H. Clark for calling my attention to this publication.

<sup>21</sup> *Victorian Nat.*, vol. 29, no. 1, 1912.

*Syngnathus foliatus* of Shaw.<sup>22</sup> This species is now usually placed in the genus *Phyllopteryx* Swainson.

While Perry doubtfully erects his genus *Hippocampus*, it is probably sufficient to satisfy the requirements of the code. He evidently established his *Hippocampus* independently of Rafinesque, and the names as used by the two refer to two distinct genera by the application of the rules of nomenclature now in force. Perry's *Hippocampus* is monotypic and is based on *S. foliatus* Shaw, which is now considered to be generically distinct from *S. hippocampus* Linnaeus, the genotype of Rafinesque's genus *Hippocampus*. Since both authors published in the same year, 1810, the question comes up as to whose name has priority. Perry's plate is dated May 1, and this may be taken as the actual date of publication, although this may not be so, according to our present ideas as to what constitutes "publication." Rafinesque's work does not give the date on the title page any more specific than 1810, while his dedication is dated April 1, 1810. It is therefore possible that Rafinesque's work was published before Perry's, although this is uncertain. In any case there is room for reasonable doubt, and the actual date of publication, in a technical sense, of either work may never be determined with certainty. In a doubtful case such as this, current and well-established usage should be followed. Rafinesque's work, therefore, is assumed to have priority, and the generic name *Hippocampus* is here used in the same sense as it has almost universally been employed by systematists.

Even if it were definitely proved that Perry's work has priority, it would still be most desirable to continue the use of the name *Hippocampus* for the seahorses. This clearly is a case where to follow the law of priority would cause more confusion than to follow general usage. Indeed, it would be nothing short of the ridiculous to replace a name that has been used by nearly all authors, including some pre-Linnaean writers, and to substitute another name for it because of the discovery of an old neglected publication of which only a few copies are in existence. Even Perry himself placed the seahorses proper in his genus *Hippocampus*, but his first monotypic use of that name may have to be applied to a different genus according to the rules.

The other place in Perry's *Arcana* to be considered is a plate of a seahorse dated December 1, 1810. The accompanying letter press is headed: "*Genus*—*Syngnathus*; or, *Hippocampus*/ *Species Erectus*." The locality is given as "native of the American seas, and of the coasts adjacent to Mexico and the West Indies." Perry does not state whether he describes a new species or substitutes the specific

<sup>22</sup> General zoology or systematic natural history . . . , vol. 5, p. 456, pl. 180, 1804.

name *erectus* for *S. hippocampus* Linnaeus to avoid tautonymy. Since he gives no reference to Linnaeus and since the locality given by Perry is different from that given by Linnaeus for his *S. hippocampus*, we have to assume that he intended here to describe another species of the genus *Hippocampus* as understood by him; and Perry cannot be said to have definitely restricted the specific name *hippocampus* of Linnaeus. Perry's account of his *erectus*, in the figure, the inadequate description, and the locality, agrees most nearly with the seahorse here recognized as *punctulatus*, but this is not at all certain, and the name *erectus* is here doubtfully placed in the synonymy of *punctulatus* (see remarks on p. 566).

Leach<sup>23</sup> quite definitely restricted the use of the specific name *hippocampus*. This author evidently established the genus *Hippocampus* independently, since he refers neither to Rafinesque nor to Perry. Leach splits up the seahorses proper, apparently being the first binomial and post-Linnaean writer to do so in a single issue of a publication, into three species: (1) *H. trimaculatus*, a new species, which he states to be "very abundant in the Indian and Chinese seas"; (2) *H. antiquorum* from the Mediterranean; and (3) *H. ramulosus*, a new species described from material in the "Mus. Britain." without any definite locality. Leach's account of *H. antiquorum* is as follows:

"H. corpore angulis subtuberculatus; crista rugosa; oculis superne gulaque utrinque tuberculo obtuso armatis. / Syngnathus Hippocampus. Auctorum. / Habitat in mari Mediterraneo, a Dom Risso optime descriptus. / Common Hippocampus. / Angles of body slightly tuberculated; crest rough; eyes above and throat on each side armed with an obtuse tubercle. / Inhabits the Mediterranean sea, and is well known under the titles, *Sea-horse*, or *Cheval-marin*."

Leach, having established the genus *Hippocampus*, evidently substituted the name *H. antiquorum* for *S. hippocampus* to avoid tautonymy; and having split up the seahorses into three species he restricted the specific name *hippocampus*, for which he substituted *antiquorum*, to a seahorse occurring in the Mediterranean. We know now, however, that there are two common and distinct species of seahorses on the northern coast of the Mediterranean, one with a short snout and blunt tubercles and the other with a longer snout and pointed and better-developed tubercles, and the question then comes up as to which species of the two the name *hippocampus* is to be applied. Leach gives under his *antiquorum* "angles of body slightly tuberculated", while for his *ramulosus* he gives "angles of body tuberculated." Since he paid due attention to that character, the name *antiquorum* was based on the Mediterranean species having nearly

<sup>23</sup> The zoological miscellany, vol. 1, pp. 103-105, 1814.

obsolescent tubercles and a short snout. Linnaeus' name *hippocampus*, for which *antiquorum* was a substitute, must therefore also be used for the common short-snouted Mediterranean species.

Leach's *ramulosus*, from an unknown locality, apparently is based largely on the presence of many rather long, branched filaments. The original account may apply to several species. For instance, some younger specimens of *hudsonius* and *punctulatus* that I have examined approach closely the figure of *ramulosus* in the nature of the development of their filaments. Rauther<sup>24</sup> figures a specimen of *H. hippocampus* having quite a number of branched filaments, and one of *guttulatus*<sup>25</sup> having many rather long though simple filaments. I also found filaments present in variable numbers in all species of which well-preserved specimens were available, and this is probably true of all species of *Hippocampus* (p. 511).

It is evident that *ramulosus* cannot be distinguished definitely on the basis of the original account, and the difficulty of its final determination is increased by the absence of a definite locality record. Risso cites Leach's species 3, or *ramulosus*, in the synonymy of his *antiquus*, which, in turn, is a synonym of *hippocampus* (see p. 521), but this action does not seem to be well taken. The original figure of *ramulosus* shows a rather deep body, more as in *hippocampus*, but the tubercles are distinctly higher than in *hippocampus* and more nearly resemble those of *guttulatus*. The depth, and length of the snout, would also not absolutely preclude it from being a *guttulatus*. Rauther (see preceding paragraph) figures a specimen of *guttulatus* having filaments nearly to the same extent as shown on the figure of *ramulosus*, although in Rauther's fish the filaments were not branched. When the original account of *ramulosus* is considered in connection with the specific characters of the common European species as established here, the probabilities favor the conclusion that *ramulosus* was based on a specimen of *guttulatus*, and Leach's name is here placed in the synonymy of *guttulatus*. This action should be considered final, unless, of course, a restudy of the type should prove otherwise; the question must be left open for those who may have a chance to reexamine the original specimen.

The third species established by Leach, *trimaculatus*, falls outside the scope of this paper.

The next author whose work has a bearing on the nomenclature of the seahorses is Cuvier,<sup>26</sup> who also established *Hippocampus*, as a subgenus, possibly again independently, since he does not refer that name to any previous author. After describing his subgenus, he states:

<sup>24</sup> Die Syngnathiden des Golfes von Neapel, pl. 16, fig. 173, 1925.

<sup>25</sup> Ibid., pl. 2, fig. 12.

<sup>26</sup> Le règne animal. . . , vol. 2, p. 157, 1817.

"Il s'en trouve dans nos mers une espèce à museau plus court, pointillée de blanc. (*Syng. hippocampus* L.) Bl. 109, fig. 3. Et une autre à museau plus long, Will. I. 25, f. 4, qui n'ont toutes deux que quelques filaments sur le museau et sur le corps."

Cuvier thus differentiates two species in "nos mers", correctly giving one striking character that distinguishes them. For one he cites the name *Syngnathus hippocampus*, but leaves the other unnamed. (This was later named by Schinz.)

We must digress here from the regular chronological arrangement of this review and turn briefly to Willughby.<sup>27</sup> This author is pre-Linnaean and largely nonbinomial, and his work need not be considered by itself. In the preceding quotation, however, Cuvier cites one of Willughby's figures, and this account by Cuvier later formed the basis of Schinz's *longirostris*. Also, Cuvier still later established three species citing Willughby's three figures, one for each of his species. The accounts of these two post-Linnaean authors are very inadequate, and in order to dispose of their names properly a consideration of Willughby's account becomes important.

The section in Willughby's book dealing with the seahorses is headed: "Hippocampus Rondeletii & aliorum. . ." No other species is mentioned by name in the letter-press account, which is largely generic and insufficient to distinguish separate species. His work also includes a plate containing, among others, three crude figures of supposedly distinct species of seahorses. Figure 3 is labeled "H Rond.", while figures 4 and 5 are named polynomially, but the alleged specific characters implied in these polynomial designations are insufficient to distinguish the species. Figure 3 shows a short snout and is probably a poor representation of the common short-snouted Mediterranean species. Figure 5 shows a medium long snout, while figure 4 shows a notably long snout, but neither figure is definitely recognizable. As to localities, for figure 5 "India Occidentalis [sic]" is given on the plate after the polynomial designation. No localities are given on the plate for the other two figures. In his letter-press account the only localities he mentions are Mediterranean, and his intention apparently was for figures 3 and 4 to represent Mediterranean species, but this is not altogether certain. Since a knowledge of the locality to be assigned to figure 4 is of importance in disposing of the names later based on that figure, it may be noted that Cuvier first cited (see above) that figure under a species from "nos mers", which he characterized but did not name. Whatever Willughby's intention was, this citation by Cuvier evidently restricted Willughby's figure 4 to a French species.

<sup>27</sup> *Historia piscium* . . . , pp. 157-158, tab. I 25, figs. 3-5, 1636.



To return to the chronological arrangement of the post-Linnaean authors, we next take up Schinz.<sup>23</sup> The account of the seahorses by this author, which was neglected by most later writers, is as follows, in full:

"Das Seepferdchen, *Hyppocampus brevirostris*. / Syngnath. hippocampus. Bl. 109. F. 3. / Der Rumpf sieben, der Schwanz viereckig, der Rüssel vollkommen walzenförmig, weiss punktiert. Im Mittelmeer und andern Meeren\*\*)." In a footnote, as indicated, he adds, "\*\*\**Hyppocamp. longirostris*. Will. I. 25. F. 4. Beide arten haben nur einige Muskelfasern am Körper."

Evidently Schinz merely supplied names to the two species found in "nos mers", as differentiated by Cuvier (1817), although the locality Schinz gives is somewhat different from that given by Cuvier, "Mittelmeer und andern Meeren" instead of "nos mers." There is no question as to the disposition of Schinz's name *brevirostris*. Since he cites *S. hippocampus* in the synonymy of that species, he evidently substituted *brevirostris* for *hippocampus* to avoid tautonymy. Therefore, Schinz's *brevirostris* must be suppressed as a synonym of *hippocampus*. The latter name is thus restricted by Schinz to a short-snouted species, and since it was previously restricted by Leach to a Mediterranean species, it must be used for the common short-snouted Mediterranean seahorse, a conclusion to which we previously arrived (p. 518).

There may be some question as to the disposition of the name *longirostris*. Did Schinz intend to apply the locality "Mittelmeer und andern Meeren" to *brevirostris* only, or to *longirostris* as well? And if the latter is answered affirmatively, did Schinz intend to include all long-snouted seahorses in one species, or to apply *longirostris* only to those found in French waters? It is futile, however, to speculate now regarding his intention. The question must be determined by the available evidence. Schinz's work is virtually a translation, or at least a rendering closely following that of Cuvier (1817), including the account of the seahorses, with the exception noted in the preceding paragraph. The chief characters that Cuvier used to distinguish his two species are now employed by Schinz to coin the Latin names of those species. Schinz, as well as Cuvier, cites Willughby's figure 4, and that figure, outside the structural character implied in Schinz's name, is practically the sole basis of his *longirostris*. Schinz's account, therefore, is virtually based on that of Cuvier, and the name *longirostris* must be applied to a species from "nos mers" or to a long-snouted seahorse occurring in French waters. It will be shown hereafter that the long-snouted seahorses on the coasts of France consist of two subspecies, one in the Atlantic and another in the Mediterranean, and it becomes necessary further

<sup>23</sup> Das Thierreich von Cuvier, vol. 2, p. 262, 1822.

to restrict Schinz's *longirostris*. As far as I know this was not done by any previous author, and the name *longirostris*, therefore, is here formally restricted to a seahorse from the Mediterranean.

Risso<sup>29</sup> described two species of seahorses, *H. antiquus* and *H. rosaceus*. The descriptions are evidently erroneous in some important particulars, somewhat conflicting in their statements when compared with specimens of the common species, and he apparently relied on the color to a large extent to distinguish the species. A comparison of his two descriptions, however, allows the identification of Risso's species with some measure of confidence. For the first-named species he states: "Angulis subtuberculatis; \* \* \* la queue présente quatre faces longitudinales avec quatre rangées d'anneaux ornés d'une houppe de filaments déliés; la tête est grande, le museau étroit \* \* \* couleur générale d'un vert obscur varié de teintes brunes"; while for the second species he states, "la tête est plus grosse, le museau un peu plus large \* \* \* sa surface est d'un beau rose tendre, pointillée de blanc et d'azur \* \* \*". A comparison with the two common Mediterranean species will show that these statements give a fair although incomplete characterization by which the two species may be distinguished. Therefore, as far as the original accounts are concerned, *antiquus* becomes a synonym of *hippocampus*, and *rosaceus* has been anticipated by *longirostris* Schinz. The rose color, which Risso describes for his *rosaceus*, is a certain color phase sometimes found in either species, according to Rauther.<sup>30</sup>

As mentioned, Risso's statements are rather conflicting, as when he describes *antiquus* in his Latin diagnosis as having "angulis subtuberculatis", and farther on, in the description, states, "le corps \* \* \* ceint de treize anneaux garnis de tubercules pointus." As far as the adults are concerned the presence of pointed tubercles would apply more nearly to the long-snouted species, but also to young specimens of the other species, *H. hippocampus*, and Risso may have drawn that statement from young fish. It is also quite possible that he did not properly separate his material, having relied on color to a large extent, and that his *antiquus* is a composite of two species, but on the basis of the original descriptions the best disposition of his two names is as indicated. In any case, the disposition of his names does not affect the nomenclature and merely relates to the proper segregation of the synonymy, since Risso has been anticipated and earlier names are available for both common Mediterranean species.

Cuvier<sup>31</sup> introduced three names for seahorses, as follows: "Il s'en trouve dans nos mers une espèce à museau plus court (*Hipp. brevi-*

<sup>29</sup> Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes maritimes, vol. 3, pp. 183, 184, 1826.

<sup>30</sup> Die Syngnathiden des Golfes von Neapel, pl. 2, figs. 15-16, 1925.

<sup>31</sup> Le règne animal . . . , ed. 2, vol. 2, p. 363, 1829.

*rostris*, N.), Will., pl. J. 25, fig. 3. Et une autre à museau plus long (*Hipp. guttulatus*, N.), Will. J. 25, f. 5, qui n'ont toutes deux que quelques filaments sur le museau et sur le corps. Il y en a aussi de voisines dans les deux Indes." In a footnote, as indicated, he adds: "<sup>1</sup>*Syng. longirostris*, N., Will., J. 25, f. 4, et d'autres espèces que nous ferons connaître dans notre grande Ichtyologie."

Comparing this with Cuvier's account in his first edition of "Le Règne Animal" (see p. 519), we note that both accounts are essentially the same. He even employs the same phraseology in describing the two French species that he recognized. He now supplies the two French species with names and also names a third species from "les deux Indes." However, while his description is essentially the same in both editions, he makes some important changes in his citations. For the short-snouted French species he substitutes the reference to Willughby's figure 3 for that to Bloch; for the long-snouted French species he now cites Willughby's figure 5 instead of figure 4, although Willughby assigns figure 5 to a West Indian species; and he introduces a third species, *longirostris*, from "les deux Indes", for which he cites figure 4, although previously, in 1817, he assigned figure 4 to a species from "nos mers." A study of the species and a comparison with the figures of Willughby and Bloch make Cuvier's intention apparent. The snout in Willughby's figure 3 is approximately the same as in either one of the two short-snouted French species; figure 5 instead of figure 4 has the snout more nearly like the long-snouted French species, while seahorses with snouts more or less the same length as in figure 4 are present in the Indo-Pacific region. Cuvier apparently now examined specimens of this notably long-snouted species and changed his citations to accord more nearly with his newly acquired material. His intention then was to cite Willughby's figures as examples of what the material he examined looked like, rather than to accept Willughby's account in full. Evidently, for this same reason, his first reference to Bloch's figure under the short-snouted seahorse is omitted in the second edition, because that figure shows a rather long-snouted species, and this was, consequently, also a necessary correction. Such an explanation becomes apparent after one becomes familiar with the appearance of the species.

Comparing Cuvier's account with that of Schinz makes it evident that the *brevirostris* of both is the same species and is to be replaced by *hippocampus*, as already shown. Like other early authors, Cuvier, being opposed to tautonymy, changed the name of a species when it corresponded with the generic name, and evidently adopted the name first proposed by Schinz for that species. However, for his other French species, the one having a "museau plus long" and inhabiting "nos mers", Cuvier does not adopt Schinz's name *longirostris*, probably regarding it as inappropriate, since he apparently

now had a species with a still longer snout from "les deux Indes"; and he consequently introduces a new name, *guttulatus*, for the French species. Although he does not definitely state so, his *guttulatus* must be regarded as a substitute for Schinz's *longirostris* on the basis of available evidence, both of those names having been based on the same account, in the first edition of Cuvier's "Le Règne Animal." Since two subspecies of long-snouted seahorses exist on the coasts of France, one in the Atlantic and another in the Mediterranean, it becomes necessary to restrict the name *guttulatus* also. It seems that no previous author made this restriction, although I do not have all the literature readily available for consultation. Since the name *guttulatus* was evidently proposed as a substitute for *longirostris* Schinz, the two names must go together. Anyway, *guttulatus* is herewith formally restricted to the population of the common long-snouted species, which occurs on the northern Mediterranean coast. Cuvier's statement "museau plus long" also applies more nearly to the Mediterranean seahorse, which averages a longer snout than its Atlantic close relative designated below as *multiannularis* (see table 2). Furthermore, the best and most adequate current accounts of *guttulatus* are based largely on Mediterranean specimens. I follow general usage and continue to employ Cuvier's name *guttulatus* for that subspecies rather than Schinz's earlier name *longirostris* (p. 546).

Cuvier's *longirostris* from "les deux Indes" was evidently not intended to be the same as the *longirostris* of Schinz, although both refer to Willughby's figure 4. That figure was previously restricted by Cuvier (1817) to a French species for which Schinz subsequently proposed the name *longirostris*. Cuvier's later (1829) assignment of the same figure to a species from "les deux Indes", therefore, must be held nomenclatorially untenable, although zoologically it was an appropriate emendation, the long-snouted seahorses from the Indo-Pacific region having their snout more nearly as shown in Willughby's figure 4. Consequently, the *longirostris* of Cuvier is a composite of two things: (1) A figure, nomenclatorially at least, belonging to a French species, and (2) a locality belonging to a different species. If we exclude the figure, *longirostris* of Cuvier becomes a nomen nudum, and if the locality is excluded, it must be regarded nomenclatorially to be the same as *longirostris* Schinz. Moreover, it is pre-occupied by *longirostris* Schinz. In any case, therefore, it is untenable. The name *H. longirostris* Cuvier was later used for two distinct species of seahorses in different parts of the world, first by Schlegel<sup>32</sup> for a Japanese species and later by Kaup<sup>33</sup> for a West Indian species. The West Indian species has been renamed as a

<sup>32</sup> In Siebold's Fauna Japonica, Pisces, p. 274, 1842.

<sup>33</sup> Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 12, 1856.

result of the present study (see p. 572), while the Japanese species was supplied with a name by Jordan and Snyder.<sup>34</sup>

Finally, it is necessary to discuss a short note on *Hippocampus* published by de la Pylaie.<sup>35</sup> His account is as follows:

"Parmi les petites espèces qui complètent cette classe, nous avons encore les Syngnathes proprement dits, *Syng. Acus. Pelagicus* Linn. ou *Aciculus* Dep., *S. Rondeletii*, *Ophidion*, auxquels il faut ajouter l'Hippocampe, *Hippocampus*, dont l'espèce de l'océan, *H. atrichus*, N., est distincte d'une autre, *H. Jubatus*, ainsi nommé d'après des filaments qui composent, le long de son cou, une espèce de crinière peu fournie."

This author based his new species, *atrichus*, entirely on the difference in the relative development of the filaments, a character that does not distinguish any one species. Probably in all species of *Hippocampus* the relative development of the filaments or even their entire absence is due to individual variation, and to a certain extent it is dependent on age, as has been discussed at greater length (p. 510). Since this is the only character mentioned by de la Pylaie, his description of *atrichus* is applicable to every species of *Hippocampus* and can be regarded practically as nothing more than a nomen nudum, or at the most as an unidentifiable species.

What de la Pylaie understood as "*H. Jubatus*" is not clear to me. I do not know of any other post-Linnaean writer who applied that name to a seahorse; it is probably cited from some pre-Linnaean author. Perhaps he had the following statement by Willughby<sup>36</sup> in mind: "Vidimis Venetiis hujus generis jubatum, nescimus an specie diversum, an aetate aut sexsu tantum." If de la Pylaie cited *jubatus* as the name of a pre-Linnaean writer, it evidently cannot be recognized in nomenclature; even if it had been established by that author, it is a nomen nudum and of no standing in nomenclature.

To dispose of de la Pylaie's two names, they are here placed doubtfully in synonymy, *jubatus* in that of *hippocampus* and *atrichus* in that of the new subspecies *multiannularis*, here described from the Bay of Biscay. The name of de la Pylaie is not adopted for the new subspecies because it was based on a misapprehension and would give an incorrect description of the species. While any legitimately established name stands even though it erroneously describes the species, in the present case we are not obliged to perpetuate de la Pylaie's error.

<sup>34</sup> Proc. U. S. Nat. Mus., vol. 24, p. 14, pl. 3, 1901.

<sup>35</sup> Recherches en France sur les poissons de l'océan pendant les années 1832 et 1833. Congr. Sci. France, Poitiers, 1834, 2d sess., p. 528, 1835. Dr. Carl L. Hubbs kindly called my attention to this reference, and the quotation given is taken from Dr. Hubbs' letter, the original account not being available for consultation.

<sup>36</sup> Historia piscium . . . , p. 158, 1686.

To sum up briefly the foregoing review of the literature, *hippocampus* Linnaeus must be applied to the common short-snouted Mediterranean species as restricted by Leach. The specific names *heptagonus* Rafinesque, *antiquorum* Leach, and *brevirostris* Schinz, having been proposed as substitutes for *hippocampus*, must be reduced to the synonymy of that species. The names proposed for the long-snouted European species are *longirostris* Schinz (1822) and *guttulatus* Cuvier (1829). The latter is a substitute for the former, and both names must go together. The later name is here employed, in accordance with universal usage. Since the Mediterranean long-snouted seahorse is now shown to be subspecifically distinct from that of the Atlantic, the name *longirostris* and its substitute *guttulatus* are here restricted to the Mediterranean subspecies, to accord with general usage. Risso's two names, *antiquus* and *rosaceus*, are referred to the synonymy of *hippocampus* and *guttulatus*, respectively. De la Pylaie's *atrichus* is unidentifiable, while his *jubatus* is unavailable either because it is pre-Linnaean or else because it represents a nomen nudum. These names are disposed of by placing them in the synonymy of *multiannularis* and *hippocampus*, respectively. The specific names *erectus* Perry, 1810, and *ramulosus* Leach, 1814, are doubtfully referred to the synonymy of *punctulatus* Guichenot, 1853, and *guttulatus* Cuvier, 1829, respectively.

I have based this discussion entirely on the published accounts, not having opportunity to examine original material. Since the original material, in some cases at least, evidently represented composites of more than one species, and since the early writers were not in the habit of designating "holotypes", the conclusions drawn from the original accounts will probably have to stand; but it may be necessary to modify these conclusions if it is ever possible to examine some of the original material.

#### Genus HIPPOCAMPUS Rafinesque

Head forming an angle with the trunk, movable up or down for a considerable distance, with the "throat" region as its axis. Brood pouch an enclosed naked sac under anterior part of tail. Pectoral, dorsal, and anal fins present, caudal absent. Tail prehensile; quadrangular; except first segment, normally hexangular in nearly all species; sometimes quadrangular (as a rather infrequent individual variation, in most species, and becoming the dominant condition in the subgenus *Jamsus*). Trunk septangular, except the posterior segments; last segment typically octangular (often hexangular in *zosteræ*); penultimate trunk segment usually septangular, sometimes novemangular (as an infrequent individual variation in most species, becoming nearly dominant in *ingens* and being the normal condition

in the subgenus *Macleayina*). Extra plates on top for support of dorsal usually two, varying one to three; usually on first caudal and last trunk segments, sometimes also on penultimate trunk segment, sometimes either on last trunk or on first caudal segment only. Upper ridge of trunk discontinuous with upper ridge of tail, the two ridges usually overlapping on two segments, varying one to three, on those segments having extra plates for support of the dorsal. (For a full discussion of the correlation between the extra plates, the modified segments, and the overlap of the ridges, see pp. 505 to 507.) Median ridge of trunk continuous with lower ridge of tail; lower lateral ridge of trunk ending on last segment; midventral ridge of trunk ending on penultimate segment. A lateral expansion or wing extending from lower plate of last trunk segment, converging with its fellow from the opposite side and uniting behind base of anal fin. Points of intersection of transverse and longitudinal ridges bearing pointed spinous processes in the very young, usually persistent as short tubercles in grown specimens, in some species becoming nearly obsolescent or reduced to low stumps, the tubercles usually somewhat better developed in females. Lateral line present, indicated by a series of paired, minute, pimplelike appendages, each pair forming tiny lips for a minute slitlike pore; a pair of lips on transverse ridge of each segment, the series of pairs arranged regularly in a nearly straight longitudinal line, running on trunk nearer to median lateral than to upper ridge continued in a nearly straight line on the tail, situated there nearer to upper than to lower ridge. Appendages on tubercles and coronet often present, often branched, often altogether absent, depending on individual variation and to a certain extent on age and on the species (see p. 510).

KEY TO THE SUBGENERA AND THE AMERICAN AND EUROPEAN SPECIES OF  
HIPPOCAMPUS<sup>37</sup>

- a<sup>1</sup>. Dorsal rays 16 to 31. Pectoral rays 13 or more. Upper ridges of trunk and tail usually overlapping on two or three segments, infrequently on one (in *hudsonius* as an individual variation). First caudal segment hexangular, infrequently quadrangular as an individual variation. Base of dorsal over 3 to 6 segments, usually including first caudal segment.
- b<sup>1</sup>. Dorsal rays 26 to 31. Caudal segments 44 to 49. Upper ridges of tail and trunk usually overlapping on three segments. Dorsal usually over 6 segments. Trunk segments 12 or 13. Subgenus **MACLEAYINA** (p. 529)
- b<sup>2</sup>. Dorsal rays 16 to 21. Caudal segments 33 to 40. Upper ridges of tail and trunk usually overlapping on two segments, infrequently on one or three as an individual variation (with exception of *ingens* about as often on three as on two). Dorsal usually over 3 segments, sometimes partly or wholly on a fourth segment. Subgenus **HIPPOCAMPUS** (p. 530)
- c<sup>1</sup>. Trunk segments normally 11, sometimes 12, rarely 10 as an individual variation (10 segments in one specimen of *hudsonius* out of entire number studied).
- d<sup>1</sup>. Tubercles on upper ridge either well developed and more or less pointed or at least narrowly rounded above, or else nearly obsolescent, not in the form of broad and low stumps.
- e<sup>1</sup>. Tubercles on upper ridge comparatively well developed and conspicuous, at least in specimens up to about 150 mm long (except usually obsolescent on trunk in large males of *punctulatus* and *kincaidi* less than 150 mm long).
- f<sup>1</sup>. Trunk without dark transverse lines or large blotches; white dots on side of trunk numerous. Northern Mediterranean, eastern Atlantic, and eastern Pacific coasts.
- g<sup>1</sup>. Snout in medium-sized females (118 mm or less) long, more than 10 percent of length; relatively long also in males when like sizes are compared; trunk comparatively slender when like sizes are compared (see table 2). Whitish dots often very profuse, minute, and subequal all over, tending to form very fine white streaks. Profusely covered with small dark spots. Penultimate trunk segments about as often novemangular as septangular (slightly oftener novemangular in the specimens examined). Attains to a large maximum size. Pacific coast of North and South America. *ingens* (p. 534)
- g<sup>2</sup>. Snout not more than 9.9 percent of length in both sexes in medium and large specimens. Trunk averages deeper. Whitish dots usually not so profuse, coarser on trunk and head, often coalescent there to form short irregular bands or

<sup>37</sup> The purpose of this key is twofold: (1) To give a synopsis of the most important specific characters in concise form, and (2) to facilitate the identification of specimens. The student is warned, however, not to expect to be able to "run down" specimens in every case by the use of this key. It is impossible to construct such an ideal key for the species of *Hippocampus*. One important drawback to the construction of such a key in this genus is the necessity of using the structure of the tubercles for specific distinctions. While the differences may be appreciated readily when specimens are directly compared, it is impossible to convey in descriptive phrases an adequate picture of these differences. Moreover, the structure of the tubercles differs considerably with size and sex in the same species, and human language is not graded finely enough to express these differences and their variation, except in general terms. This key, therefore, may be used to full advantage only in connection with authentic specimens for comparison. However, at least full-grown or medium-sized fish may be identified by the use of this key, together with the tables giving the frequency distributions of the meristic characters and the ranges of proportional measurements, and with a knowledge of the locality of capture of the specimens to be identified.



- elongate spots. Many small dark spots typically absent. Penultimate trunk segment septangular in a decidedly predominant number of specimens, sometimes novemangular. Attains to but a medium maximum size.
- h*<sup>1</sup>. Snout 7.7 to 9.9 percent of length in medium-sized and large specimens of both sexes. Pectoral rays 15 to 18.
- i*<sup>1</sup>. Caudal segments modally 39, varying 38 to 40; dorsal rays modally 20, varying 19 to 21. Snout averaging shorter, postorbital longer, trunk longer and slenderer (see table 2). White dots coarser and more numerous. Atlantic coast of Europe-----*guttulatus multiannularis* (p. 540)
- i*<sup>2</sup>. Caudal segments modally 38, varying 36 to 39; dorsal rays modally 19, varying 18 to 21. Mediterranean coast of Europe-----*guttulatus guttulatus* (p. 543)
- h*<sup>2</sup>. Snout 5.9 to 7.3 percent of length in medium-sized specimens of both sexes. Pectoral rays 13 to 15. Caudal segments 36 to 38. Dorsal rays 17 to 19. Atlantic coast of Europe.  
*europaeus* (p. 546)
- f*<sup>2</sup>. Trunk with large yellowish or whitish or variegated blotches in young, usually partly or wholly replaced with brownish lines in full-grown specimens. White dots on side of trunk very sparse. Western Atlantic.
- g*<sup>1</sup>. Caudal segments usually 36 to 38, varying 35 to 39; dorsal and pectoral rays in comparatively smaller average numbers; trunk in full-grown specimens rather deep; tubercles well developed; snout medium; white dots usually not profuse. Atlantic and Gulf coasts of United States, north and west of Florida-----*hudsonius hudsonius* (p. 551)
- g*<sup>2</sup>. Caudal segments usually 35 to 37, varying 33 to 37; dorsal and pectoral rays in comparatively larger average numbers; trunk in full-grown specimens notably deep; tubercles comparatively not so well developed, sometimes nearly obsolescent in full-grown males; snout rather long; white dots usually profuse except on side of trunk. Florida and Cuba.  
*hudsonius punctulatus* (p. 561)
- g*<sup>3</sup>. Caudal segments usually 35 or 36, varying 33 to 36; dorsal rays in comparatively smaller average numbers; pectoral rays in medium numbers; trunk of medium depth; tubercles usually rather low, tending to become nearly obsolescent in large males; snout medium. Bermuda-----*hudsonius kincaidi* (p. 568)
- e*<sup>2</sup>. Tubercles on upper ridge in medium-sized and large specimens obsolescent or nearly so, or very low and narrowly rounded above, not pointed, not forming broad stout stumps. Typically covered profusely with small brown spots.
- f*<sup>1</sup>. Snout 6.1 to 7.9 percent of length and depth 16.4 to 19.4 in specimens 68 to 104 mm long. Pectoral rays modally 14, varying 13 to 15. Coronet blunt but not low. Tubercles on upper ridge of trunk usually evident as low rounded elevations. Mediterranean-----*hippocampus* (p. 570)
- f*<sup>2</sup>. Snout 10 to 12.7 percent of length and depth 12 to 15.3 in specimens 58 to 137 mm long of both sexes. Pectoral rays usually 15 or 16, varying 15 to 17. Coronet very low. Tubercles on upper ridge of trunk mostly obsolescent in large specimens. Panama to Bermuda-----*reidi* (p. 572)

- d<sup>2</sup>. Development of tubercles on upper ridge peculiar, low, stout, and blunt, not pointed, not obsolescent; in form of low knoblike stumps. Slender, depth in medium-sized specimens not over 13.7 percent.
- e<sup>1</sup>. Dorsal rays 17; caudal segments 35. Atlantic coast of United States ----- *obtusus* (p. 576)
- e<sup>2</sup>. Dorsal rays 20 to 21; caudal segments 39. Pacific coast of Panama. *hildebrandi* (p. 579)
- c<sup>2</sup>. Trunk segments 10 (one specimen examined). Tubercles well developed and pointed. With large blotches. Trunk deep ----- *villosus* (p. 582)
- a<sup>2</sup>. Dorsal rays 10 to 14. Pectoral rays 10 to 12. Upper ridges of trunk and tail normally overlapping on one segment, infrequently on two, rarely on more. First caudal segment oftenest quadrangular, sometimes hexangular (an infrequent individual variation in *regulus*, frequent in *zosteræ*). Base of dorsal normally over two segments, usually the last two trunk segments, sometimes over the first caudal and last trunk segments. Trunk segments usually 10, sometimes 9, infrequently 11. Caudal segments 28 to 34 ----- Subgenus **JAMSUS** (p. 584)
- b<sup>1</sup>. Dorsal rays with mode decidedly at 11, varying 10 to 12. Caudal segments usually 29 to 31, varying 28 to 32. Trunk segments nearly always 10. Maximum size 34 mm. Mississippi and Texas coasts; Campeche, Mexico ----- *regulus* (p. 584)
- b<sup>2</sup>. Dorsal rays with mode decidedly at 12, varying 11 to 14. Caudal segments usually 31 to 33, varying 30 to 34. Trunk segments 9 or 10 (depending on the racial stock), sometimes 11. Maximum size 44 mm. Florida, Biscayne Bay to Pensacola ----- *zosteræ* (p. 589)

#### Subgenus MACLEAYINA Fowler

*Macleayina* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, p. 426, 1907.  
(Genotype: *Hippocampus abdominalis* Lesson = *H. bleekeri* Fowler by original designation.)

This subgenus was originally established on the basis of the increased number of dorsal rays. Correlated with this is the position of the dorsal base, usually on one caudal and five trunk segments. It also differs in having the upper ridges of tail and trunk overlapping normally on three segments instead of on two, the dominant condition in the subgenus *Hippocampus*. While this difference may seem slight, it is correlated with a more fundamental difference in structure, each segment on which the two ridges overlap also having an extra plate on top for the support of the dorsal (see pp. 505 to 507). In this respect the species *ingens* is somewhat intermediate between *Macleayina* and *Hippocampus*. *Macleayina* also has an increased number of caudal segments and a higher average number of trunk segments. According to McCulloch<sup>38</sup> it contains five species. Of the species listed by McCulloch, however, *bleekeri* and *agnesæ* have been synonymized with *abdominalis* by Fowler,<sup>39</sup> while *graciliformis* has been placed in the synonymy of the same species by Waite and Hale.<sup>40</sup> The one or

<sup>38</sup> Mem. Australian Mus., vol. 5, p. 97, 1929.

<sup>39</sup> Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 446, 1921.

<sup>40</sup> Rec. South Australian Mus., vol. 1, p. 319, 1921.

more species comprising this subgenus are geographically outside the scope of the present paper, and, moreover, sufficient material for comparison is not available. Consequently, the species are not treated further here.

### Subgenus HIPPOCAMPUS Rafinesque<sup>a</sup>

*Hippocampus* RAFINESQUE, Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia . . ., p. 18, 1810. [Genotype: *H. hippocampus* (Linnaeus) = *Syngnathus hippocampus* Linnaeus = *H. pentagonus* Rafinesque by absolute tautonymy.]

*Hippocampus* LEACH, The zoological miscellany, vol. 1, p. 103, 1814. [Genotype: *H. hippocampus* (Linnaeus) = *H. antiquorum* Leach by absolute tautonymy.]

*Hippocampus* CUVIER, Le règne animal . . ., vol. 2, p. 157, 1817. [Genotype: *H. hippocampus* (Linnaeus) = *Syngnathus hippocampus* Linnaeus by absolute tautonymy and by monotypy.]

*Farlapiscis* WHITLEY, Australian Zool., vol. 6, p. 313, 1931. (Genotype: *H. breviceps* Peters by original designation.)

The species of this subgenus that were studied form a compact group, which may be sharply distinguished from the subgenus *Macleayina* on the one hand and from *Jamsus* on the other as indicated in the key. Whether this sharp distinction will hold when the other species of seahorses are studied in detail remains to be seen.

The necessity for the new generic name introduced by Whitley is not clear, and he gives no reason for establishing it. As far as I can judge by current descriptions, *H. breviceps*, the genotype of Whitley's *Farlapiscis*, belongs to the typical subgenus *Hippocampus*.

TABLE 1.—Frequency distribution of the number of caudal segments and fin rays in nine species or subspecies of the subgenus *Hippocampus*

Species and locality	Caudal segments								Dorsal rays								Pectoral rays							
	33	34	35	36	37	38	39	40	15	16	17	18	19	20	21		13	14	15	16	17	18	19	
<i>ingens</i> .....						2	6	2					8	2	1				2	8	1			
<i>multiannularis</i> : At- lantic coast of Eu- rope.....						3	9	2					5	10	1				1	5	5	3		
<i>guttulatus</i> : Mediter- ranean coast of Europe.....				1	5	15	2					2	13	7	1				2	13	7	1		
<i>europaeus</i> .....				3	3	1					1	4	3				1	3	4					
<i>hippocampus</i> .....		1	6	3						1	10						2	8	1					
<i>reidi</i> .....		1	5	3	2				1	1	6	1							4	4	1			
<i>kincaidi</i> : Bermuda.....	1	1	2	2								4	2						1	4	1			
<i>punctulatus</i> : Florida and Cuba.....	1		8	10	7							2	17	8	2				3	14	9	1	1	
<i>hudsonius</i> : North and South Carolina.....			1	7	8	1					1	8	10	1					4	12	1			
Mississippi to Texas.....			1	5	10	2						7	9	2					3	11	4			
Virginia to Maine.....			3	7	15	7	4			2	1	13	18	2				5	17	12	2			

<sup>a</sup> See also p. 515 for a discussion of Perry's use of this generic name.

TABLE 2.—*Ranges and averages of proportional measurements of five species or subspecies of Hippocampus from the eastern Pacific, the eastern Atlantic, and the Mediterranean, segregated by size and sex, expressed as percentages of the length*<sup>1</sup>

Length (mm)	Sex	Num-ber meas-ured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age
<i>Hippocampus ingens</i>																
107-201	♂	2	13.4-15.4	14.4	9 - 9.5	9.3	8.9-9.1	9.0	20- 21	20.5	31.8-31.9	31.9	64.2-65.3	64.8	3.1-3.3	3.2
118-158	♀	5	12.2-13.8	13.1	9.4-10.6	10.2	8.5- 9.9	9.3	21.9-22.7	22.2	32.3-34.4	33.4	60.2-63.2	61.6	3.4-4.0	3.7
118	♂	1	13.4	13.4	-----	9.4	-----	9.5	-----	21.2	-----	33.5	-----	61.5	-----	3.9
87-95	♀	2	11.0-12.3	12.0	10.2-10.4	10.3	9.7-10.0	10.2	23 -23.9	23.5	33.1-33.2	33.2	61.0-62.2	61.9	4.2-4.5	4.4
<i>Hippocampus guttulatus multiannularis</i> —Atlantic coast of Europe																
101-131	♂	7	13.4-16.4	15.1	7.7-9.0	8.3	9.8-11.0	10.4	20.9-23.6	22.1	31.5-33.4	32.3	63.6-65.7	64.5	4.1-4.7	4.4
103-113	♀	7	12.0-14.1	12.9	8.1-9.2	8.4	10.1-10.9	10.6	21.7-23.6	22.5	32.5-35.2	33.4	61.7-64.0	62.9	4.4-4.8	4.6
<i>Hippocampus guttulatus guttulatus</i> —Mediterranean coast of Europe																
90-103	♂	6	14.4-17.4	16.1	8.5-9.2	8.9	9.3-10.1	9.8	21.4-22.7	22.0	29.7-31.9	31.0	63.3-65.8	64.6	4.2-4.9	4.6
90-110	♀	4	12.8-16.4	14.3	8.8-9.4	9.0	9.2-10.5	9.9	20.9-22.5	21.8	31.8-32.6	32.3	62.3-65.1	63.5	4.2-4.6	4.4
72-88	♂	7	12.5-16.8	14.7	8.9-9.9	9.3	9.7-10.8	10.4	22.0-24.5	23.1	31.8-33.5	32.7	62.2-64.6	63.0	4.7-5.4	5.0
78-88	♀	5	12.3-16.5	13.9	8.8-9.9	9.5	9.8-10.8	10.2	22.1-24.6	23.1	30.9-34.1	32.5	61.4-63.9	63.2	4.6-5.1	4.8
<i>Hippocampus europaeus</i>																
95-113	(?)	4	13.7-16.7	15.5	5.0-6.9	6.4	9.1-10.2	9.7	18.7-19.7	19.3	29.7-33.1	32.1	62.1-65.2	63.4	3.8-4.2	4.0
84-88	-----	3	13.3-14.6	14.0	6.9-7.3	7.1	10.0-10.1	10.0	20.0-21.4	20.9	32.1-33.1	32.6	61.9-64	63.0	4.3-4.9	4.7

<sup>1</sup> For description of method of taking measurements, see pp. 507 to 509. The segregation of the material according to sex is probably not absolutely correct, as discussed on p. 510.

<sup>2</sup> Nearly all specimens examined either had a brood pouch or at least a rudiment of one, and the segregation of the specimens tabulated is by size only (see pp. 550 and 571).

TABLE 2.—*Ranges and averages of proportional measurements of five species or subspecies of Hippocampus from the eastern Pacific, the eastern Atlantic, and the Mediterranean, segregated by size and sex, expressed as percentages of the length*—Continued

Length (mm)	Sex	Num- ber meas- ured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age
<i>Hippocampus hippocampus</i>																
98-104	(?)	3	17.7-19.4	18.8	6.1-6.9	6.4	10.1-10.3	10.2	19.2-20.5	19.7	29.6-30.8	30.3	61.2-65.8	64.0	3.9-4.4	4.1
88-89		6	10.4-18.7	17.2	6.7-7.9	7.3	10.9-11.3	11.2	21.1-23.5	22.2	31.5-33.7	32.3	60.7-64.1	63.0	4.7-5.1	4.8
60		1	-----	15.3	-----	8.2	-----	12.0	-----	24.0	-----	-----	-----	60.8	-----	5.5

† Nearly all specimens examined either had a brood pouch or at least a rudiment of one, and the segregation of the specimens tabulated is by size only (see pp. 550 and 571).

TABLE 3.—*Proportional measurements of Hippocampus reidi and the subspecies and populations of Hippocampus hudsonius* <sup>1</sup>

Length (mm)	Sex	Num- ber meas- ured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age	Range	Aver- age		
<i>Hippocampus reidi</i>																
121	♂	1	15.2	10.0	9.8	22.6	33.4	62.2	3.6							
127-137	♀	2	12 - 12.4	10.2-11.0	10.6	22.7-23.6	34.9-35.8	59.2-63.0	3.9							
74-82	♂	2	14.1-15.2	10.2-11.2	10.7	21 -26.5	34.3-36.2	59.2-61	4.6							
88-93	♀	2	13.3-15.1	11.7-12.7	12.2	20.9-27.1	35.8-36.9	58.5-59	4.9							
46	♂	1	11.3	11.7	11.1	26.5	37.4	56.5	5.7							
50	♀	1	12	10	11.8	26.4	38.0	55.6	6.0							

*Hippocampus hudsonius kneri*—Bermuda

118.....	♂	1	18.0	8.1	10.3	22.3	32.6	65.0	4.5
76-88.....	♂	3	16.2-18.9	8.7-9.9	9.8-10.6	20.4-24.8	32.0-33.2	62.7-63.2	4.9
60-61.....	♀	2	13.9-14.0	9.8-10.3	10.1	25.0-26.1	37.2-37.6	58.4-59.8	5.1

*Hippocampus hudsonius punctatus*—Florida and Cuba

100-102.....	♂	8	19.0-22.1	20.7	10.1-11.3	10.9	22.0-26.4	24.2	33.0-36.8	34.8	59.2-62.7	61.3	3.9-4.7	4.2
92-142.....	♀	7	18.1-20.1	10.1	9.3-11.3	10.2	10.4-12.2	11.4	23.3-26.4	24.7	58.7-61.7	59.7	3.7-4.7	4.3
60-91.....	♂	2	15.4-16.3	15.9	10.7-12.1	11.4	11.4-12.7	12.1	27.0-27.5	27.3	56.5-57.0	56.8	4.4-5.8	5.1
40-40.....	♀	5	12.7-16.0	14.4	10.2-12.3	11.2	10.7-12.9	11.6	24.9-26.2	27.0	54.7-58.4	56.0	5.1-5.8	5.3

*Hippocampus hudsonius*—North and South Carolina

98-102.....	♂	2	18.0-18.3	18.2	8.0-8.0	8.0	9.8-10.6	10.2	21.0-22.3	21.7	20.8-31.5	30.7	61.4-65.3	64.9	4.2-4.4	4.3
90-110.....	♀	5	15.3-18.9	17.4	7.7-10.0	9.2	10.8-11.3	11.0	21.0-24.5	23.6	32.9-34.9	34.2	58.8-62.4	60.2	4.2-5.4	4.3
70-88.....	♂	5	15.0-19.3	16.9	7.4-9.4	8.2	10.0-11.4	10.8	20.7-23.9	22.5	30.7-33.8	31.9	61.5-64.4	63.1	4.3-5.6	4.9
48-70.....	♀	3	12.7-10.2	14.0	7.9-12.5	10.2	10.6-11.8	11.1	22.9-27.5	25.2	33.3-36.0	31.3	57.3-62.4	60.4	4.7-5.2	4.9

*Hippocampus hudsonius*—Mississippi to Texas

68-130.....	♂	0	18.1-20.3	19	7.7-8.7	8.2	10.0-11.2	10.5	20.9-23.3	22.5	31.3-33.1	32.1	62.0-65.0	61.1	3.8-4.8	4.1
110.....	♀	1	15.9-18.7	17.2	8.1	8.1	10.0-11.2	10.3	20.9-23.3	21.2	35.3	35.3	58.0-62.8	60.8	3.9-5.3	4.6
58-81.....	♂	5	13.3-16.0	14.0	8.1-9.8	9.0	10.0-12.6	11.6	23.4-25.4	24.1	32.6-35.3	33.7	58.7-61.9	60.4	4.5-5.0	5.2
48-70.....	♀	4	13.3-16.0	14.0	8.9-10.0	9.6	10.4-11.5	11.1	24.4-25.4	24.9	32.6-36.0	36.5	56.8	56.8	0.5	0.5
43.....	♂	1	15.4	15.4	10.9	10.9	12.3	12.3	27.9	27.9	34.7	34.7	58.8	58.8	0.3	0.3
42.....	♀	1	10.0	10.0	10.1	10.1	12.0	12.0	26.5	26.5	34.7	34.7	58.8	58.8	0.3	0.3

*Hippocampus hudsonius*—Virginia to Maine

95-150.....	♂	9	16.3-20.3	18.4	7.0-8.3	7.8	9.9-11.2	10.3	20.2-22.4	21.2	29.0-35.8	32.7	61.7-68.7	63.7	3.0-4.7	4.1
80-95.....	♀	6	13.4-17.1	15.5	8.3-10.6	9.3	9.7-11.3	10.3	21.8-24.2	22.8	33.0-36.9	34.2	57.8-63.0	60.4	4.0-1.8	4.4
50-70.....	♂	5	14.3-17.0	15.6	7.7-9.3	8.4	10.5-12.3	11.3	21.8-26.5	23.4	31.4-34.9	33.0	60.2-63.9	62.0	4.9-5.9	5.2
50-68.....	♀	6	13.3-15.6	14.5	7.7-11.9	8.9	10.2-12.0	11.1	21.8-24.0	23.4	32.2-36.8	33.5	58.8-61.0	60.8	4.4-5.5	5.0

1 See footnote 1 to table 2.

## HIPPOCAMPUS INGENS Girard

## FIGURE 55

*Hippocampus ingens* GIRARD, in Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, vol. 10, pt. 4, Fishes, p. 342, 1859. (San Diego, Calif.)

*Hippocampus gracilis* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 283. (Cape St. Lucas, Calif.)

*Hippocampus ingens* JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 776, 1896. (*H. gracilis* placed in synonymy of *ingens*.)

*Hippocampus ecuadorensis* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 446, fig. 2, 1921. (Bahia, Ecuador.)

*Hippocampus ingens* MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 256, 1923. (Chame Point and Panama City market, Panama.)

*Diagnosis*.—First caudal segment hexangular<sup>42</sup> (in 10 specimens studied, injured in one); last trunk segment octangular; penultimate trunk segment septangular or novemangular (completely septangular in four and novemangular in four, incompletely novemangular in two); antepenultimate and the preceding trunk segments septangular. In other words, an extra plate on first caudal and last one or two trunk segments; or, upper ridges of tail and trunk overlapping on two or three segments. Trunk segments usually 11 (in seven), sometimes 12 (the twelfth segment complete in one specimen, incomplete<sup>43</sup> in two; all these three specimens having the penultimate trunk segment with an extra plate). Caudal segments 38 to 40. Dorsal rays modally 19, varying 19 to 21. Pectoral rays modally 16, varying 15 to 17. Tubercles well developed in medium-sized fish, usually pointed, sometimes rather stubby but high; becoming almost obliterated in largest males, somewhat better developed in large females. Coronet of medium height in medium-sized fish of both sexes and in large females, somewhat lower in large males. Trunk notably slender; snout long. Filaments very few and rather short (present only in the medium-sized specimens examined). Profusely covered with many small rounded brown spots, somewhat as in *reidi*; small whitish or silvery dots often unusually profuse, characteristically tending to an arrangement into irregular rows and often tending to coalesce into fine white streaks irregularly spreading over nearly entire tail, trunk, and head. Dorsal with a submarginal dark streak typically present, often obscure; margin over dark streak hyaline, more or less dusky or diffusely spotted below the streak; sometimes entire dorsal nearly colorless. (For counts and measurements see tables 1 and 2.)

<sup>42</sup> For a discussion of the modification in the structure of the first caudal and posterior trunk segments in the species of *Hippocampus* and of the various ways in which this modification may be expressed, see pp. 505 to 507.

<sup>43</sup> See p. 504 for explanation of an incomplete trunk segment.

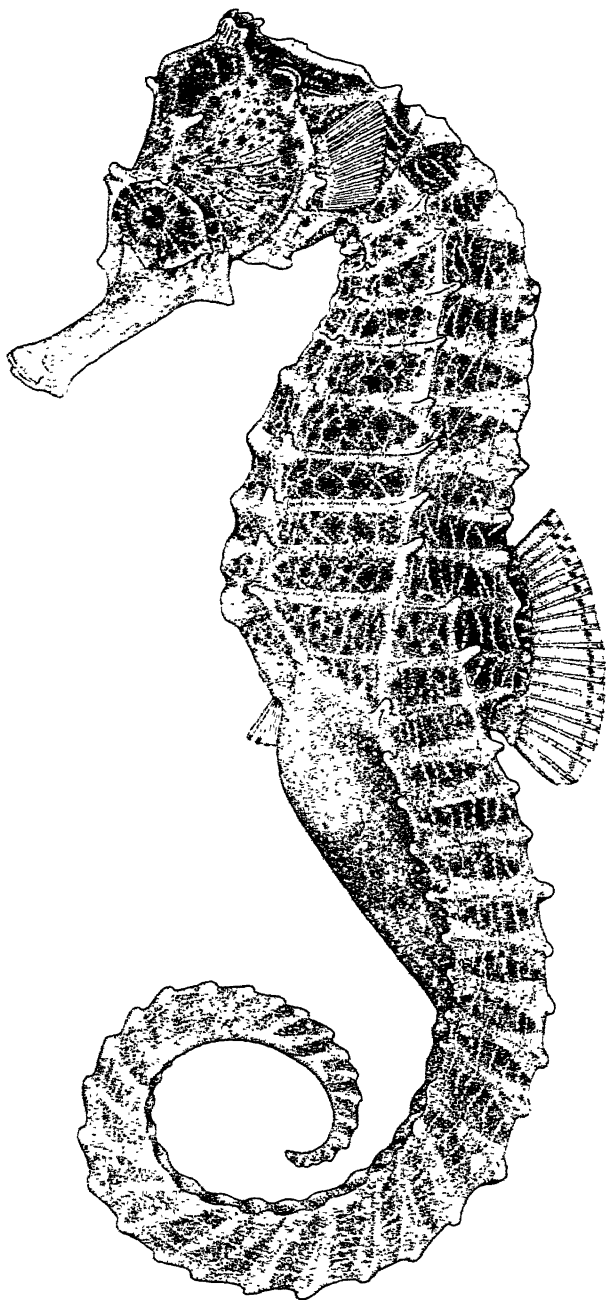


FIGURE 55.—*Hippocampus ingens*, drawn from a male, 201 mm long, from Panama; U.S.N.M. no. 79683. Length of specimen as drawn, 127 mm. (The latter stated length in this and other figures refers to the distance between two horizontal lines forming the boundaries of the specimen as drawn, a tangent through the outermost coil in the tail and a horizontal through the uppermost point on the head or "neck.")



*Distinctive characters and relationships.*—In practice no difficulty will be found in identifying specimens belonging to this species. Only one other species, *hildebrandi*, is now known to occur within the range of *ingens*. The differences between the two are discussed under the account of *hildebrandi* (p. 579), which is saliently distinct from *ingens*.

This species differs from all others of its subgenus treated herein in its large size and in the fact that the upper ridges of the tail and trunk overlap on three segments as often as on two, possibly even oftener on three, whereas in the other species the normal overlap is on two segments with an overlap on three as a rather infrequent individual variation. In this respect *ingens* forms a transition between *Hippocampus* proper and the subgenus *Macleayina*.

While there is no doubt that *ingens* is quite distinct and no author ever questioned its distinctive nature, it is remarkable that it shows no structural characters by which it may be sharply delimited from some other American or European species of *Hippocampus*, which possibly are not even closely related to it. This furnishes an illustration of the difficulties encountered in properly distinguishing the species of *Hippocampus* by the ordinary morphological methods. In its slender body, long snout, color pattern, and tendency for the tubercles to become obsolescent with age it closely approaches or agrees with *reidi*, differing in having more numerous caudal segments and dorsal rays; but the two species closely approach each other in those characters even in the comparatively few specimens studied. When a large specimen of *reidi* is compared with specimens of *ingens* of similar size—specimens of such length may be considered to be only of medium size in *ingens*—the former appears markedly different on account of its obsolescent tubercles; but in full-grown specimens of *ingens* the tubercles on the trunk also become rather obsolescent, especially in full-grown males.

As far as the structural characters are concerned, *ingens* is even nearer to *guttulatus* from the Mediterranean, or *multiannularis* from the Atlantic coast of Europe, closely agreeing with those two subspecies in the number of caudal segments, pectoral rays, and dorsal rays and being nearer to the former in its dorsal rays and nearer to the latter in its caudal segments. It differs from both in having a longer snout and, on the average, a slenderer body and a characteristic profusion of small dark spots. The length of the snout possibly will also be found to intergrade when larger series are measured. It is also closely related to *hudsonius* from the Atlantic coast of North America, *ingens* differing chiefly in the color pattern, but in structural characters the two species more or less overlap, although the averages or frequency distributions are decidedly different. While *ingens*, in general, differs from *hudsonius* in its structural characters in approxi-

mately the same manner as it differs from *guttulatus* or *multiannularis*, in the frequency distribution of its meristic characters it is nearer to the European species than to the American *hudsonius* (see table 1). As stated, it differs from *hudsonius*, *guttulatus*, *multiannularis*, *reidi*, and others in tending strongly to have an extra plate on the penultimate trunk segment, and as a consequence the upper ridges of the tail and trunk overlap on three segments about as often as on two, or, in other words, the penultimate segment is novemangular nearly as often as septangular. Quite likely this character is an important and suggestive indicator of phylogenetic relationship, in spite of the fact that it is shown only by half, or slightly more than half, of the population.

*Material examined and geographic distribution.*—San Diego, Calif.; A. Cassidy; four cotypes (982).<sup>44</sup> Mazatlan, Mexico; J. G. Ortega (86239). Chame Point, Panama; March 8–14, 1913; R. Tweedlie (82038). Panama City market; Meek and Hildebrand (79682, April 1912; 79683, 1912; 79684, March 22, 1912). Panama Bay, lat. 7°57' S., long. 78°55' W.; March 5, 1888, *Albatross* (43404). Salinas, Ecuador; September 17, 1926; Dr. Waldo L. Schmitt (88833, in bad condition but evidently the present species).

Total number of specimens studied, 11; three with a brood pouch, 113 to 201 mm long, seven without any trace of a brood pouch, 87 to 158 mm (one specimen broken, sex and length indeterminable). The localities from which specimens were examined represent a range from San Diego, Calif., to Salinas, Ecuador.

*Synonymy.*—I follow previous authors in placing *H. gracilis* in the synonymy of *ingens*, although the original description is not sufficiently detailed to be certain of such reference. Since the type is evidently lost this is probably the best course to take, unless another species turns up from that region. The account of *H. ecuadorensis* shows that it was apparently based on a specimen of *ingens*. Fowler states that his new species "differs from *H. ingens* in more dorsal rays, larger eye, blunt body and tail rings, and the absence of dermal flaps." The 11 specimens examined have 19 to 21 dorsal rays, and it is consequently reasonable to expect that 22 rays, as in the type of *ecuadorensis*, falls within the range of variation; the blunt rings and the absence of dermal flap are usual in large specimens. The size of the eye is too variable to be employed by itself in distinguishing species. The color pattern, as indicated by the description and figure, is typical of *ingens*.

<sup>44</sup> Unless otherwise specified, the numbers given in parentheses throughout this paper are U. S. National Museum catalog numbers. Data without numbers refer to specimens in the U. S. Bureau of Fisheries.



FIGURE 56.—*Hippocampus guttulatus multiannularis*, new subspecies, drawn from a paratype; Univ. Michigan Mus. no. 111748, 110 mm long. Length of specimen as drawn, 63 mm. The long appendages are fleshy filaments, not spines.

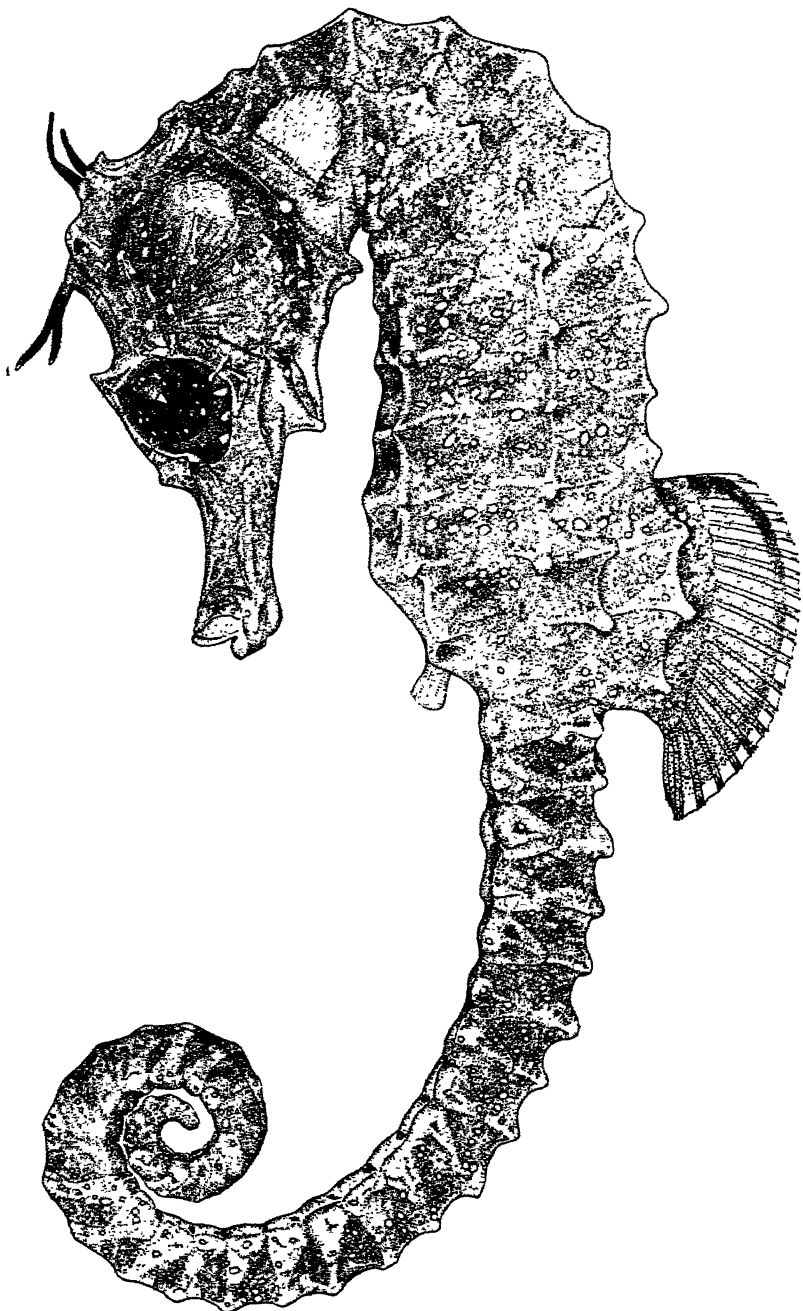


FIGURE 57.—*Hippocampus guttulatus multiannularis*, new subspecies, drawn from a female paratype 113 mm long. Length of specimen as drawn, 62 mm.

## HIPPOCAMPUS GUTTULATUS MULTIANNULARIS, new subspecies

## FIGURES 56, 57

*Hippocampus atrichus* DE LA PYLAIE, Congr. Sci. France, Poitiers, 1834, 2d sess., p. 528, 1835 (see p. 524).

*Hippocampus antiquorum* DAY (not Leach), The fishes of Great Britain and Ireland, vol. 2, p. 265, pl. 144, fig. 7, 1880 (the figure has a rather long snout and was probably drawn from a specimen of the present subspecies).

*Hippocampus guttulatus* DUNCKER (not Cuvier, as here restricted, see p. 546), Die Tierwelt der Nord- und Ostsee, pt. 12g, p. 23, 1926 (the description and the figure agree fairly well with the present subspecies, and if that account includes Atlantic coast specimens they should probably be referred to it).

*Diagnosis.*—First caudal segment hexangular and last trunk segment octangular (in all 16 specimens examined); antepenultimate segment nearly always septangular (incompletely novemangular in only one of the 16 specimens examined). In other words, nearly always extra plates on first caudal and last trunk segments only; or upper ridges of tail and trunk overlapping on two segments only (with the single exception noted). Trunk segments 11 (in all 16 specimens examined). Caudal segments modally 39, varying 38 to 40. Dorsal rays usually 19 or 20, varying 19 to 21. Pectoral rays oftenest 16 or 17, varying 15 to 18. Tubercles rather low but conspicuous. Coronet of medium height, preceded by a double bony hump of nearly same height and almost fused with it, producing the effect, when viewed from the side, of an unusually wide and comparatively low coronet. Trunk rather slender, snout of medium length. Most specimens, both males and females, with a few short filaments on coronet and postorbital spines, sometimes also a few on anterior spines of upper ridge of trunk. Specimens having the color fairly well preserved nearly uniformly colored, rather dark, profusely sprinkled with small white dots, comparatively coarse, especially on head and trunk, sometimes a few white dots coalescing there to form elongate spots or short irregular lines. (See tables 1 and 2 for counts and measurements.)

*Distinctive characters and relationships.*—As already noted, the common seahorses occurring on the Atlantic coast of Europe have hitherto been generally regarded by authors as belonging to one species and referred to either one or the other of the two common Mediterranean species. If the locality of the specimens forming the basis of the present account is correct, however (see p. 541), it shows that on the coasts of Europe two common species occur in the Atlantic as well as in the Mediterranean. The two European Atlantic coast seahorses may be distinguished chiefly by the correlation of a shorter snout and fewer caudal segments in one, while the other has a longer snout in combination with more numerous caudal segments. The apparent reason for the prevalent "opinion" that only one species

exists on the Atlantic coast is the greater difficulty of distinguishing the two forms occurring there, while the two Mediterranean species are more readily distinguishable and were consequently recognized by nearly all more recent authors.

The Atlantic short-snouted seahorse differs specifically from the short-snouted Mediterranean species and is treated herein under the name of *H. europaeus*. The other Atlantic seahorse is rather long-snouted and is apparently specifically identical with the long-snouted Mediterranean species, *guttulatus*, but the Atlantic coast population diverges sufficiently to be recognized as a distinct subspecies and is here described as *multiannularis*.

The differences between the subspecies *guttulatus* and *multiannularis* may be readily appreciated by a study of tables 1 and 2. It will be noted that *multiannularis* has a distinctly higher caudal segment count, the mode being at 39 instead of 38. To a lesser extent it also averages a higher dorsal ray count and possibly a higher pectoral ray count. In proportional measurements *multiannularis* has, on the average, a slenderer trunk, a slightly shorter snout, a rather longer postorbital distance, and a slightly longer trunk and shorter tail, although there are usually more tail segments. The white spots in *multiannularis* are usually somewhat coarser and more numerous. The tubercles and coronet are perhaps not so well developed as in *guttulatus*, but these structures vary greatly with age, and their variations in both subspecies remain to be established more definitely. The two subspecies differ somewhat as *hudsonius* and *punctulatus* differ on the American coasts.

The difference between *multiannularis* and its congener occurring in the same region, *europaeus*, may also be gathered by a study of tables 1 and 2, *europaeus* saliently differing in having fewer caudal segments and dorsal and pectoral rays and a shorter snout, but the exact degree of divergence between the two Atlantic seahorses remains to be determined. Out of 24 specimens examined, representing both forms, all were readily referred to their proper species or subspecies, except one somewhat doubtful specimen, which is described in some detail on page 542.

*Material examined and geographic distribution.*—The origin of the specimens on which the foregoing account is based is to some extent uncertain and is here explained in detail. Dr. Carl L. Hubbs kindly sent me a lot of 20 seahorses from the collection of the Michigan University Museum of Zoology for study, three of them more or less damaged, the other 17 in fair or good condition. This lot was originally kept alive on exhibition in the New York Aquarium and according to Dr. Hubbs came "supposedly from the Bay of Biscay." In order to trace their origin more definitely I wrote to C. M. Breder, Jr., associate director of the New York Aquarium, who replied that

the seahorses were presented to the aquarium by E. O. Freund. of Chicago, that Mr. Freund purchased the specimens from Dagry Frères of Paris, and that they were said to have been caught in the Bay of Biscay. I then wrote to Dagry Frères, who replied as follows: "Tous les cheveaux marins qui sont fournis par notre Maison proviennent du Bassin d'Arcachon dans l'Océan Atlantique." A detailed study shows that irrespective of whether the specimens from Dagry Frères were mixed with those from other sources somewhere along the line of transfer from one party to the other (see next paragraph), it is highly probable that 16 came from the Bay of Biscay. At any rate, there is hardly any question that all 16 belong to one subspecies, which is most closely related to *guttulatus*, and that they are subspecifically distinct from typical *guttulatus* from the Mediterranean.

One of the specimens in the lot possibly did come from another source. It is apparently a *hippocampus*, a Mediterranean species. This specimen is discussed at greater length on page 572.

Briefly, the present subspecies is based on eight specimens with a brood pouch, 101 to 131 mm long, and eight without a brood pouch, 103 to 113 mm long (one male and one female with the tail broken off at the end, the female possibly somewhat longer than the largest female with an unbroken tail). The locality of capture, Bay of Biscay, while apparently correct, needs to be verified. The difference in geographical distribution between *multiannularis* and the typical subspecies of *guttulatus* remains to be worked out.

*Holotype*.—Univ. Michigan Mus. no. 111747; the brood pouch of medium development; caudal segments 40, dorsal rays 20; pectoral rays 18; length 108 mm; depth 15.5, snout 9, postorbital 11, trunk 33, tail 63.5 and orbit 4.5 percent of length (these measurements and counts are included in the tables and in the foregoing diagnosis). The locality of the type indicated above.

*Paratypes*.—Univ. Michigan Mus. no. 111748; 15 specimens in same lot with the type.

*Uncertain specimen*.—A single specimen (93733), somewhat doubtfully referred to *multiannularis*, may be described as follows: Without a brood pouch; trunk segments 11, caudal segments 39, dorsal rays 20, pectoral rays 16; length 130 mm, depth 13, snout 7.5, postorbital 11.5, head 21, trunk 33 and tail 63 percent of length. When these data are compared with tables 1 and 2, it will be noted that the counts of the meristic characters are more as in *multiannularis*, but possibly the specimen represents an extreme variant of *europaeus*. The length of the snout is rather intermediate between the specimens of *europaeus* and *multiannularis* that were measured, but nearer to the latter. Moreover, it is a large specimen, and the relative length of

the snout decreases with size; consequently, it is more likely that this specimen represents a *multiannularis*. The depth, and length of the head, are also somewhat nearer to *multiannularis*. It is one of a lot of three originally carried in the United States National Museum as no. 16454, with the locality entered as "England" with a question mark. The two smaller specimens in this lot are entirely typical of *europaeus* and are included here in the account of that species, but the specific relation of the present specimen is somewhat uncertain for the reasons stated, and is treated here separately. It may be possible to place this specimen with greater assurance after the range of variation of both species is more definitely determined by a study of larger numbers of specimens.

#### HIPPOCAMPUS GUTTULATUS GUTTULATUS Cuvier

- Hippocampus non aculeatus, incisuris raris* WILLUGHBY, Historia piscium . . . , Tab. I 25, fig. 4, 1686 (no definite locality indicated, restricted by Cuvier, 1817, to a species from "nos mers" and Cuvier's account later formed basis of Schinz's *longirostris*).
- Syngnathus hippocampus* BLOCH (in part), Naturgeschichte der ausländischen Fische, pt. 1, p. 7, pl. 109, fig. 2, 8 ed., 1786 (the figure and only part of written account apparently refer to this species).
- Hippocampus ramulosus* LEACH, The zoological miscellany, vol. 1, p. 105, pl. 47, 1814 (locality unknown; possibly based on a specimen of the present subspecies, see p. 518).
- Hippocampus* ["a museau plus long"] CUVIER, Le règne animal . . . , vol. 2, p. 157, 1817 ("nos mers"; refers to Willughby's figure 4; distinguished but not named).
- Hippocampus longirostris* SCHINZ, Das Thierreich von Cuvier, vol. 2, p. 262, 1822 (based on Cuvier's preceding account; herewith formally restricted to the Mediterranean population).
- Hippocampus rosaceus* RISSO, Histoire naturelle des principales productions de l'Europe méridionale . . . , vol. 3, p. 184, 1826 (most likely refers to present subspecies, see p. 521).
- Hippocampus guttulatus* CUVIER, Le règne animal . . . , ed. 2, vol. 2, p. 363, 1829 (evidently a substitute for *longirostris* Schinz, generally employed by authors to designate the common Mediterranean long-snouted seahorse and herewith formally restricted to the Mediterranean population).
- Hippocampus ramulosus* GÜNTHER, Catalogue of the fishes of the British Museum, vol. 8, p. 201, 1870 (account includes type of *ramulosus*).
- Hippocampus guttulatus* RAUTHER, Die Syngnathiden des Golfes von Neapel, p. 8, pl. 2, figs. 12, 14, 15, 1925 (the figure 13 is not typical of the present species, having the spines too low, the snout intermediate, and the color more as in *H. hippocampus*; Rauter gives an extensive account of the biology and anatomy of the Mediterranean species).

*Diagnosis*.—First caudal segment hexangular, last trunk segment octangular, and penultimate segment septangular (constant in all 24 specimens examined). In other words, first caudal and last trunk segment only bearing extra plates for support of the dorsal; or, upper ridges of tail and trunk overlapping on two segments. Trunk seg-



ments 11 (in all 24 available specimens). Caudal segments modally 38, varying 36 to 39. Dorsal rays modally 19, varying 18 to 21. Pectoral rays modally 16, varying 15 to 18. Spines on upper ridge of trunk fairly well developed in full-grown fish, only slightly better developed in female. Coronet fairly well developed; a humplike bony elevation preceded by a spinelike tubercle in front of coronet, the spine often becoming obsolescent, producing an effect of a double hump, the latter usually fairly discontinuous and separated from coronet, often nearly fused and having the effect of a very broad coronet when viewed laterally (resembling then that of *multiannularis*, see p. 540). Trunk of medium depth; snout of medium length. Filaments present in some of the specimens examined, relatively not numerous, sometimes rather long (many long filaments shown on one of Rauther's figures). Color (somewhat faded in the material examined) more or less profusely peppered with white dots; somewhat coarser, in form of very small white spots, on side of trunk and opercle; often coalescent there to form short, somewhat irregular elongate spots or white lines showing a tendency to a vertical arrangement on trunk and on opercle. Dorsal with a dark submarginal band, dusky below but of a lighter shade than the band. (See tables 1 and 2 for counts and measurements.)

*Distinctive characters and relationships.*—*H. guttulatus* is composed of two subspecies, the typical subspecies in the Mediterranean, and a second subspecies, *multiannularis*, on the Atlantic coast, which has already been described. The difference between the two is discussed on page 541.

The subspecies *H. guttulatus* may be readily distinguished from the other common seahorse occurring within its range, *H. hippocampus*, by its more numerous caudal segments and dorsal and pectoral rays and by its longer snout and slenderer trunk. All these characters are discontinuous or nearly so (see tables 1 and 2), and there should be no trouble in properly placing even individual fish. Furthermore, these differences are reinforced by *guttulatus* having notably better developed tubercles and a different color pattern, consisting of white dots and spots against a darker nearly uniform background, instead of the typical dark spots against a lighter background in *hippocampus*.

*H. guttulatus* is close to *hudsonius* from the American coast. In fact, as far as the structural characters are concerned, they may well be regarded as subspecies. The greatest divergence between *guttulatus* and *hudsonius* is in the average greater number of caudal segments in the former, but there is much intergradation between the two (see table 1). The trunk in *guttulatus* averages somewhat slenderer, and there are other smaller differences (see tables 1 to 3). *H. guttulatus*, too, shows some color peculiarities. It has neither the brown lines on the trunk and opercle, which are characteristic of the full-grown *hudsonius* and its subspecies *punctulatus* and *kincaidi*, nor the

large blotches on the trunk, which are especially developed in medium-sized and often persist in large specimens of these American seahorses. The white dots on the trunk of *hudsonius* are very sparse and of the same small size as those on the tail, while in *guttulatus* the white spots on the side of the trunk are characteristically larger than those on the tail, are quite profuse, and tend to coalesce, forming somewhat irregular short lines or elongate spots. Because of the different color pattern in combination with the structural differences and their widely discontinuous distribution, *hudsonius* and *guttulatus* are recognized as independent species rather than subspecies.

*H. hudsonius* is nearer in the average number of caudal segments, the most divergent character, to the typical *guttulatus* from the Mediterranean than to its subspecies *multiannularis* from the Atlantic coast of Europe. Consequently, it is quite possible that *hudsonius* and *guttulatus* are not so closely related as the specific characters investigated during this study would indicate. Attention has been called to the remarkable similarity in structural character between *guttulatus* and *ingens* (see p. 536), although there is no question as to the distinctness of these two species.

*Material studied and geographic distribution.*—Adriatic Sea; J. Smolinsky (44438, more definite locality not given). Venice; D. S. Jordan (23427 and 34356). Sicily (21164). Naples (21121 and 28550). Bay of Naples; S. E. Meek; April 1897 (48326). Genoa; D. S. Jordan (29732). Europe (93744; five specimens, more definite locality not given, but without doubt belonging to present subspecies).

Total number of specimens examined, 24, nine without a brood pouch, 78 to 110 mm long, 15 with a brood pouch or at least a rudiment of one, 72 to about 110 mm long (the largest male dried and accurate length not determinable).

The material examined comprises localities ranging from Venice to Genoa (see also discussion of specimen from Greece, p. 546). From accounts in the literature, and from the material examined, it seems evident that this subspecies is widely distributed and common on the northern coast of the Mediterranean, including the Adriatic Sea, but its more precise geographical limits still remain to be worked out. At least some of the records of "*guttulatus*" from the Atlantic coast of Europe refer to the new subspecies here described as *multiannularis*; while extant records of "*guttulatus*" from other places no doubt refer to various other species.

*Nomenclature and synonymy.*—Because of its markedly longer snout and other salient differences as compared with the other common seahorse on the northern coast of the Mediterranean, the subspecies *guttulatus* appears to have been correctly distinguished from *hippocampus* by nearly all authors, and Cuvier's name *guttulatus* has been employed most generally to designate it. Cuvier, however, was

anticipated by Schinz and possibly by two other previous authors. The name *longirostris* Schinz, 1822, certainly, and possibly *ramulosus* Leach, 1814, and *rosaceus* Risso, 1826, if the last two were based on specimens of the same species, have priority over *guttulatus* Cuvier, 1829. According to the strict application of the rules the later name *guttulatus* should be suppressed. Nevertheless, since it has become so well established general usage is here followed and the name *guttulatus* continued. This course is more expedient also for two reasons: (1) The proper application of the name *ramulosus*, which has priority over *longirostris*, must remain uncertain until the type is reexamined, and (2) a name earlier even than *ramulosus* may be discovered as applying to the form. While I attempted to examine and review all the early publications bearing on the nomenclature of the seahorses, it is quite possible that I missed some pertinent publication. As a matter of fact, I came across Schinz's name *longirostris*, which has been left out of all general lists, by mere chance. Further search may reveal a still earlier designation for this species, which would necessitate another change of name. Therefore, the use of the well-established name *guttulatus* is continued.

As stated previously, my study has shown that the populations of this species from the Atlantic and from the Mediterranean coasts are subspecifically distinct. Consequently, it becomes necessary to restrict further the application of the early names, and the name *longirostris* Schinz, as well as the later substitute name *guttulatus*, has been formally restricted to the Mediterranean population (see p. 525).

*Uncertain specimen.*—A single specimen in bad condition from Greece (45041) probably belongs to this subspecies. The dorsal and pectoral are injured and the number of rays cannot be accurately determined. Trunk segments 11, caudal segments 38, the two upper ridges overlapping on two segments; without a brood pouch; length 91 mm; depth 13, snout 11, postorbital 11, head 25.3, trunk 32.7, tail 63, and orbit 5.3 percent of length. From table 2 it may be noted that these measurements agree fairly well with *guttulatus* except in the unusually long snout. This may represent an extreme variant in that respect, or it may have some taxonomic significance, a question to be determined only by a study of more numerous specimens from Greece. It is possible that *guttulatus* is divisible into distinct populations, as are *hudsonius* or *zosteræ* (see under their accounts).

#### HIPPOCAMPUS EUROPAEUS Ginsburg

##### FIGURE 58

*Hippocampus brevirostris* YARRELL (not Schinz, 1822), A history of British fishes, vol. 2, p. 452, 1836 (England; the rather short snout shown by the figure indicates that the account is probably based on the present species).

*Hippocampus europaeus* GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 561, 1933 (La Rochelle).

*Diagnosis.*—First caudal segment hexangular and last trunk segment octangular (in all eight specimens examined); penultimate trunk segment usually septangular, often novemangular (completely

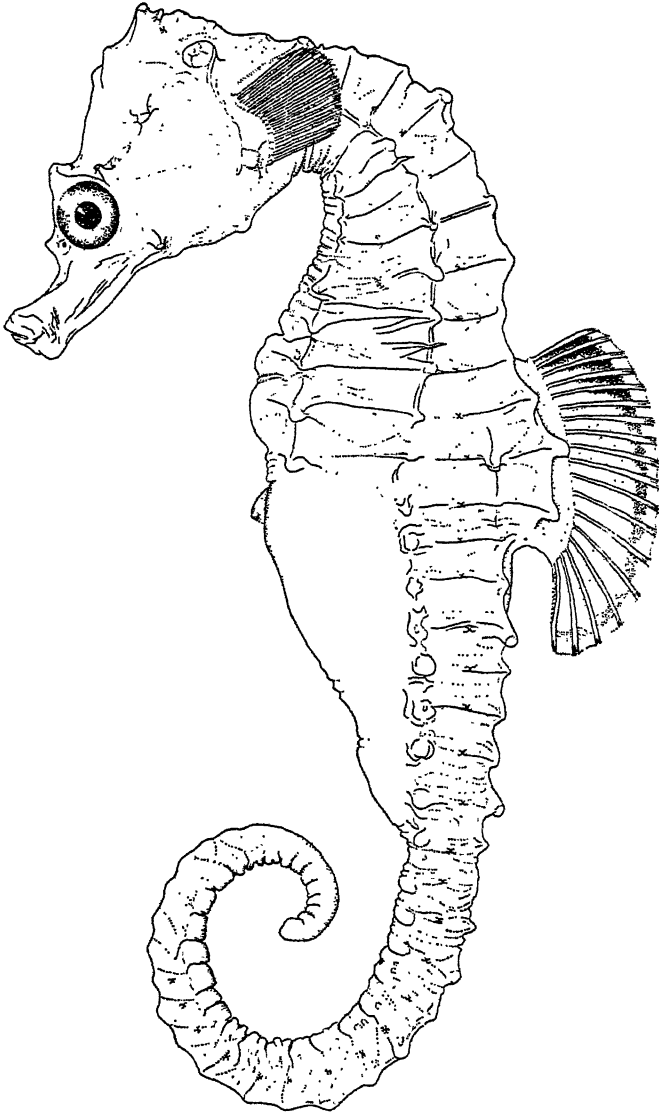


FIGURE 58.—*Hippocampus europaeus*, drawn from the type, a male 95 mm long from La Rochelle, France U.S.N.M. no. 28544. Length of specimen as drawn, 55 mm. Color faded.

septangular in five and novemangular in two, incompletely novemangular in one). In other words, an extra plate always present on first caudal and last trunk segment, often also on penultimate trunk

segment; or, upper ridges of tail and trunk usually overlapping on two segments, often on three. Trunk segments usually 11 (in six), sometimes 12 (in the two specimens noted above as having the penultimate trunk segment completely novemangular). Caudal segments usually 36 or 37, varying 36 to 38.<sup>45</sup> Dorsal rays usually 18 or 19, varying 17 to 19. Pectoral rays usually 14 or 15, varying 13 to 15. Tubercles on upper ridge of trunk conspicuous, but rather short, intermediate in development between *guttulatus* and *hippocampus*. Coronet variable, medium to rather low, double bony hump in front of it usually lower than and distinctly not continuous with it. Trunk of medium depth; snout conspicuously short. Available specimens without any filaments. Color faded in available specimens, traces of white elongate spots or short lines on opercle and trunk of two specimens. (See tables 1 and 2 for counts and measurements.)

*Distinctive characters and relationships.*—*H. europaeus* is likely to be confused with *multiannularis*, which occurs in the same region with it, and the two have apparently been so confused by most authors. The difference between them has been pointed out under the account of the latter (p. 541). This species is also near to *hippocampus* from the Mediterranean, agreeing with it in the short snout but differing in having more numerous caudal segments and dorsal rays, a slenderer body (see tables 1 and 2), and conspicuously better developed tubercles. In the two meristic characters they intergrade, but in the relative depth there are no intergradients in the specimens measured, although such may be found when larger numbers are measured. The range of variation of each species and the relation between *europaeus* and *hippocampus* still remain to be determined. It is possible that their geographic ranges overlap and that in the region where both occur some difficulty may be found in referring occasional specimens to their proper species (see discussion of uncertain specimen on p. 572).

*H. europaeus* is even nearer, in its structural characters, to *hudsonius* from the American coast, especially to its northern population, than to any European species or subspecies. It differs chiefly from *hudsonius* in having a shorter snout, and to a lesser extent in a slenderer trunk and fewer pectoral rays; but in the latter two characters there is more or less intergradation (see table 1 and compare tables 2 and 3). The typical color pattern of *europaeus* is apparently

<sup>45</sup> In the brief description of the type specimen I stated that it has 39 caudal segments. A reexamination of the specimen after I gained considerably more experience in counting the caudal segments shows that 38 is probably the correct number, but it is difficult to determine with absolute accuracy whether it has 38 or 39 unless the specimen is to be dissected. Since what appears to be the last segment is slightly longer than usual, it was thought to represent two segments. However, according to the method herein employed in counting the segments, it should be recorded more properly as having 38 caudal segments (see p. 504).

nearly the same as in *guttulatus* and unlike that of *hudsonius* (see discussion on p. 544), but in the available specimens of *europaeus* the color is not sufficiently well preserved to determine this difference more definitely.

The relationship of *europaeus* to the other species and subspecies of *Hippocampus* nearest it is quite obscure and may be interpreted in more than one way, depending on the assumption made at the start. In its short snout *europaeus* agrees closely with *hippocampus* from the Mediterranean, but in the counts of the caudal segments and dorsal and pectoral rays, as well as in the relative development of the tubercles, it is about intermediate between *hippocampus* and *multiannularis*. If we assume that *europaeus* is the more primitive form, it may follow that *hippocampus* and *multiannularis* diverged from it in different directions, one in the direction of having fewer fin rays and caudal segments and the other in the direction of having higher counts of the same characters. Also, *hippocampus* diverged in the direction of the tubercles becoming obsolescent, retaining the primitive condition of the short snout of the parent species; while *multiannularis* diverged in the direction of an increasing length of snout and a better development of the tubercle.

Again, we may assume that *multiannularis* is the more primitive form and argue that *europaeus* diverged from it in the direction of a diminishing number of segments and fin rays, a decreasing prominence of the tubercles, and a decreasing length of snout. As a further intensification of this same developmental tendency, it may be argued that *hippocampus* developed from *europaeus*. Or we may assume that *hippocampus*, or *guttulatus*, or *hudsonius* from the American coast is the more primitive form. In fact, each assumption will lead us to a different interpretation of the close relationship of these species and subspecies. The apparent relationship of *europaeus* to *guttulatus*, to *hudsonius*, and to *hippocampus* seems to indicate that *europaeus* is the more primitive form and that with it as a focal center the other three species diverged in different directions, but the evidence does not justify the unquestioned acceptance of this.

Marked features of *europaeus* are the decided tendency shown by the penultimate trunk segment to have an extra plate on top and the frequency of occurrence of 12 trunk segments. These features are shown also by *ingens* and to a much more pronounced degree than by *europaeus*. They also may indicate a more primitive condition.

*Material studied and geographic distribution.*—La Rochelle, France (28544, the type; 93217 and 21122). Also two specimens without certain locality but evidently belonging to *europaeus* (16454); they

are recorded in the National Museum as coming from "England" but with a question mark. A third and larger specimen of the same

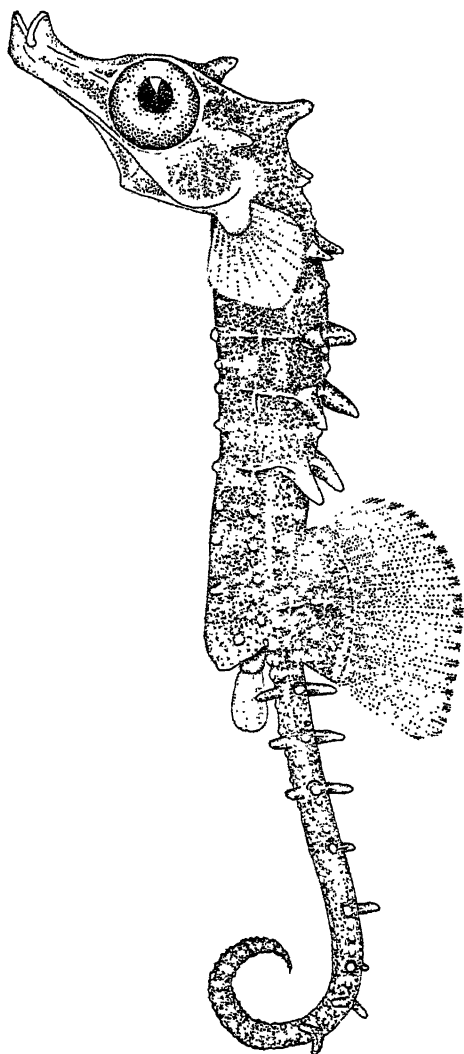


FIGURE 59.—*Hippocampus hudsonius hudsonius*, drawn from a specimen about 7 mm long from coast of North Carolina

lot agrees more nearly with *multiannularis* and is described above (p. 542); it is the only specimen out of a total of 25 examined from the Atlantic coast of Europe the relationship of which is in doubt, whether it belongs to the present species or to *multiannularis*.

Total number of specimens examined, 8, 84 to 113 mm long (tail in one specimen broken and its length unknown but evidently falling within the given range of lengths). Since *europaeus* obviously has been confused with other species, the only definite locality to which it may be assigned must be based on the material examined, namely, La Rochelle, and its precise geographical distribution still remains to be determined. All the specimens examined had either a fully developed brood pouch or at least a rudiment of one represented by an oval fold of skin or an oval pigment-ed area under the anterior part of the tail. It is possible therefore, that in *euro-*

*paeus*, as in *hippocampus*, this structure does not definitely indicate the sex (see p. 510).

## HIPPOCAMPUS HUDSONIUS HUDSONIUS De Kay

## FIGURES 59-62

- Hippocampus hudsonius* DE KAY, Zoology of New York, pt. 4, Fishes, p. 322, pl. 53, fig. 171, 1842 (New York).
- Hippocampus laevicaudatus* HECKEL, in Kaup's Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 16, pl. 2, fig. 2, 1856 (North America).
- Hippocampus hudsonius* YARROW, Proc. Acad. Nat. Sci. Philadelphia, vol. 29, p. 204, 1877 (Fort Macon, N. C.).
- Hippocampus antiquorum* GOODE (not Leach), Proc. U. S. Nat. Mus., vol. 1, p. 45, 1878 (St. Georges Banks).
- Hippocampus antiquorum* GOODE and BEAN, Amer. Journ. Sci., ser. 3, vol. 17, p. 39, 1879; also in Bull. Essex Inst., vol. 11, no. 1-3, p. 4, 1879 (Georges Bank, possibly refers to same specimen as preceding record).
- Hippocampus hudsonius* JORDAN and GILBERT, U. S. Nat. Mus. Bull. 16, p. 907, 1882 (Beaufort, N. C.).
- Hippocampus punctulatus* BEAN (not Guichenot), Bull. U. S. Fish Comm., vol. 7, p. 134, 1889 (Ocean City and Somers Point, N. J.).
- Hippocampus hudsonius* JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 777, 1896 (*laevicaudatus* placed in synonymy of *hudsonius*).
- Hippocampus hudsonius* SMITH, The fishes of North Carolina, p. 172, fig. 67, 1907 (Beaufort, N. C.).
- Hippocampus punctulatus* SMITH (not Guichenot), *ibid.*, p. 173 (Beaufort, N. C.).
- Hippocampus hudsonius* EVERMANN and HILDEBRAND, Proc. Biol. Soc. Washington, vol. 23, p. 160, 1910 (Cape Charles City).
- Hippocampus hudsonius* HILDEBRAND and SCHROEDER, Bull. U. S. Bur. Fish., vol. 43, pt. 1, p. 185, fig. 100, 1927 (Chesapeake Bay localities).

*Diagnosis.*—First caudal segment nearly always hexangular, infrequently quadrangular (completely hexangular in 71, incompletely hexangular in one, quadrangular in four specimens); last trunk segment always octangular; penultimate trunk segment nearly always septangular (in 73), infrequently novemangular (in three). In other words, last trunk and first caudal segment only having extra plates in nearly all specimens, infrequently an extra plate missing on first caudal segment or present on penultimate trunk segment; or, upper ridges of tail and trunk nearly always overlapping on two segments, infrequently on one or on three segments. Trunk segments nearly always 11, infrequently 10 (11 complete segments in 73 specimens, the eleventh segment incomplete in one, and 10 segments in only one specimen). Caudal segments usually 36 to 38, varying 35 to 39. Dorsal rays usually 18 or 19, varying 16 to 20. Pectoral rays usually 15 or 16, varying 14 to 17. (The counts differ with the populations; see discussion below.) Spines unusually long in the young, often very conspicuous in medium-sized specimens taken in deep water, relatively well developed in full-grown fish. Coronet well developed. Trunk becoming moderately deep in full-grown specimens; snout of medium length. Filaments usually present, sometimes quite profuse, often absent. Color pattern



typically changes markedly with age; juvenile color pattern consisting chiefly of light-colored blotches around the base of the spines usually more or less coalescent; in large specimens the blotched color partly or wholly replaced by a striped pattern (see below regarding change

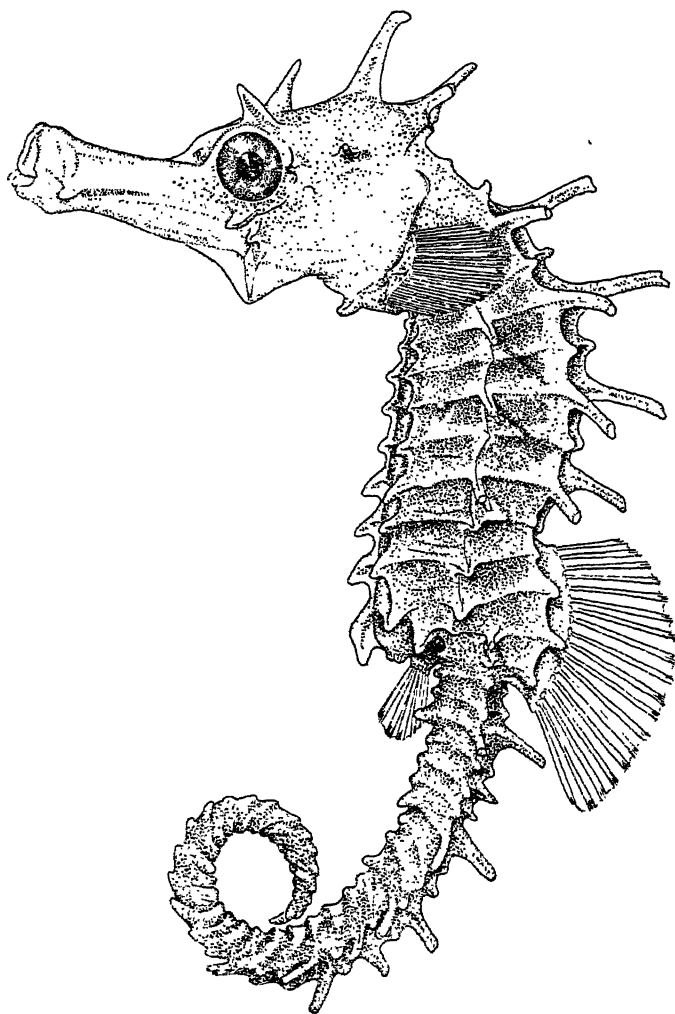


FIGURE 60.—*Hippocampus hudsonius hudsonius*, drawn from a specimen 17 mm long from Beaufort, N. C. Length of specimen as drawn, 12 mm excluding spines. The long spines are characteristic of specimens of that size.

and variability of color with size and individual fish); tail typically peppered with small light-colored dots, whitish or bluish in preservative, these dots usually present also on head, back of trunk, and base of dorsal, and much more sparsely on side of trunk; similar dots often

forming radiating rows around eye, sometimes coalescing there to form radiating lines. Dorsal margined with a hyaline band, under-



FIGURE 61.—*Hippocampus hudsonius hudsonius*, drawn from a male 50 mm long from Norflok, Va.; U. S. N. M. no. 91381. Length of specimen as drawn, 34 mm. Color pattern represented nearly typical of specimen of that size. Development of tubercle nearly typical of males of that size.

laid by a dark band broadening anteriorly to form a dark or black diffuse blotch, the dark band and blotch merging gradually with the

dusky shade of the basal part of the fin. According to Bean (1889) the dorsal, in life, is margined with yellow in the female and orange

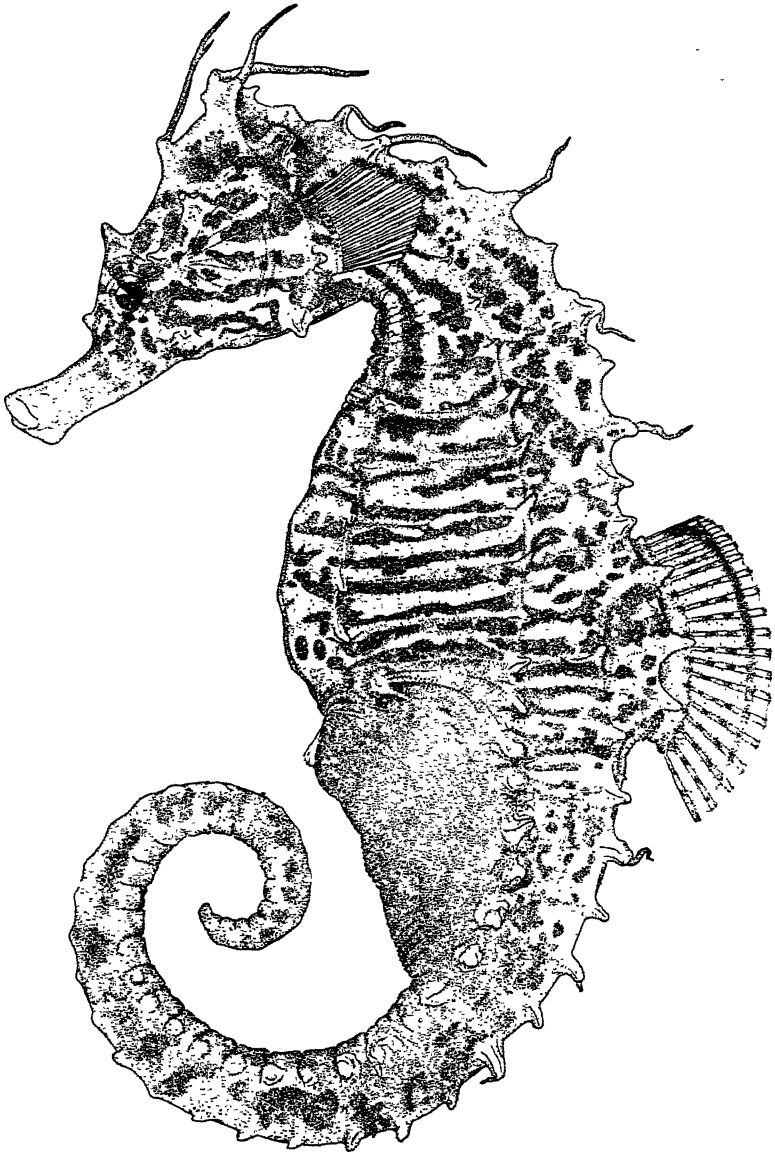


FIGURE 62.—*Hippocampus hudsonius hudsonius*, drawn from a male 130 mm long from Horn Island, Miss.; Field Mus. Nat. Hist. no. 16191. Length of specimen as drawn, 72 mm. Color pattern nearly typical of specimens of that size but more sharply marked than usual. Tubercles somewhat better developed than in most males of that size.

in the male. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

*Variability of color, spines, and appendages with age, sex, habitat, and individual fish.*—The development of filamentous processes varies primarily with the individual and to a minor extent possibly with age. Filaments, either simple or branched, are usually present in moderate numbers on the postorbital spines and those of the coronet and the upper ridge of the trunk; at least a few are present. Sometimes they are quite profuse (fig. 64) or altogether absent. When few they sometimes take the form of short chunky appendages. Specimens with a profusion of filaments were relatively more numerous in the smaller size group, while specimens with a total absence of filaments were comparatively more numerous among the larger fish; but this difference is not pronounced. In either small or large specimens filaments were sometimes profuse and sometimes altogether absent. No appreciable difference with sex in the development of filaments was noted. Small specimens often have very many tablike skinny processes, pimplelike excrescences, and short filaments, besides those on the spines, generally distributed on the head, trunk, and to a lesser extent on the tail. With growth the tabs, pimples, and shorter filaments mostly disappear.

The spines in the young (three specimens 17 to 24 mm from North Carolina examined; fig. 60) are strongly and very unequally developed; generally every alternate spine on the trunk and every third or fourth spine on the upper margin of the tail are inordinately long. These greatly elongate spines rapidly decrease in length with growth (in two specimens 32 and 33 mm the spines are considerably shorter but still relatively somewhat longer as compared with larger specimens). The relative decrease in the length of the spines with growth is somewhat unequal in the two sexes. In general, in seahorses taken in comparatively shallow water, the spines are appreciably but not strikingly unequal in males of about 50 mm long (fig. 61) and females of about 60 mm long. In full-grown specimens the spines are generally reduced to form shorter tubercles, which are either subequal or not strikingly unequal and rather short although usually well developed as compared with most other species or subspecies of *Hippocampus*. Even in full-grown specimens the tubercles are relatively somewhat better developed in females than in males, this condition being more or less evident also in the other species (see p. 509). Development of the spines or tubercles varies to a large extent with individual fish at any given size. Consequently, the foregoing remarks apply only in a general way, with frequent exceptions.

Medium-sized specimens frequently occur with unusually well developed tubercles or rather long spines (fig. 64). Such specimens occur all along the coast including the geographic range of both

subspecies, *hudsonius* and *punctulatus*. In the early part of my study such specimens were tentatively identified as *stylifer* because of their rather long spines. In putting my rough data in presentable form, however, I noted that all such specimens, with one exception, lacked any trace of a brood pouch, apparently being females or sexually undeveloped males. None were over 95 mm, and nearly all were taken in comparatively deeper water or as pelagic specimens. So far I have been unable to discover any other characters to correlate with these unusually well developed spines. In the characters chiefly relied on for the separation of the species and subspecies, counts and measurements, these specimens apparently differ in a north and south direction, on a par with the difference between the subspecies *hudsonius* and *punctulatus*. At any given latitude they agree generally in these characters with the respective populations taken in shallow water. The best explanation I have to offer is that they represent the persistence of a juvenile condition with respect to the development of the spines or tubercles. The absence of any trace of a developing brood pouch in nearly all such specimens also suggests the persistence of a juvenile condition in general.

The color varies greatly with individual fish, but a characteristic color pattern may be recognized, wholly or partly, in most fish with color well preserved. The typical color pattern differs also with age. Smaller and medium-sized fish, about 50 to 85 mm long, have a characteristic blotched appearance, with lighter blotches against a darker background (fig. 61). The light blotches are generally formed around the tubercles and are more or less coalescent. The blotches are often mottled with lighter and darker shades, sometimes with strongly contrasting nearly white and black shades. Sometimes they form figures somewhat resembling hourglasses in shape. In larger specimens the typical, juvenile, blotched color pattern is usually replaced, partly or wholly, by a striped pattern (figs. 62, 63). The trunk has narrow dark brown or black transverse lines against a lighter background. Similar lines are often present and arranged lengthwise on opercle and are continued in a longitudinal direction on the anterior part of the trunk, oftener at its lower anterior corner, where they contrast sharply with the transverse lines. Sometimes these typical lines on the trunk and opercle are broken up to form rows of elongate spots. In most of the available full-grown specimens having the color preserved, at least traces of the juvenile blotches may be discerned, but in some the striped pattern entirely replaces the blotched pattern of the young (as in fig. 62). Often large specimens have the blotches very sharply marked, large in extent but few in number. A pair of such large blotches, one above and one below, may be somewhat confluent, forming a figure roughly suggesting an hourglass (fig. 63).

Preserved specimens often do not show the typical color pattern. Some are very dark, the color pattern being then much obscured or nearly obliterated, and some are very light all over, the pattern then being very faint or nearly absent. Often specimens are irregularly mottled without any definite color pattern. However, although not always well marked and varying greatly with the individual, the typical color (consisting of a blotched pattern in the young, partly or wholly replaced by a striped pattern in large specimens) is characteristic of *hudsonius* as well as its subspecies *punctulatus* and probably also *kincaidi*. It was not observed in any of the specimens of the other species studied, except the single specimen tentatively identified as *villosus* (p. 582), which to some extent has the blotched appearance of *hudsonius*, although not so well marked as in typical specimens of the latter species.

*Distinctive characters and relationships.*—The relation of the common large seahorse of the more northern States to the one from Cuba and Florida apparently has never been definitely established, but it becomes clear by referring to tables 1 and 3. After reviewing current general works on American fishes one gets the idea that two common species of seahorses, *hudsonius* and *punctulatus*, occur on the Atlantic coast of the United States, the former ranging farther north and the latter being more southern in its distribution. According to some authors <sup>46</sup> both of these common species may be found at the same locality. This assumption is certainly an error, as the data presented herewith prove. Table 1 shows that fish from Chesapeake Bay as compared with those from Florida and Cuba average more caudal segments, fewer pectoral rays, and fewer dorsal rays (not a greater number of dorsal rays, as erroneously stated in current descriptions). As the proportional measurements of the different parts of the fish differ with age and sex, no adequate picture of the frequency distribution of these measurements could be shown by the available material, but the ranges and the averages are given in table 3. This shows that when large specimens of the same sex are compared, northern fish, on the average, have a slenderer trunk and a shorter head, shorter subdivisions of the head (snout and post-orbital), slightly shorter trunk, and somewhat longer tail; although the differences in proportional measurements nearly disappear in smaller fish. However, while tables 1 and 3 show distinct and statistically measurable differences in the seahorse populations from the extreme geographical ranges, they also show a high degree of intergradation. Furthermore, this intergradation in the structural characters is evidently gradual with geographic distribution or latitude, and fish from North and South Carolina and from Missis-

<sup>46</sup> Smith, *The fishes of North Carolina*, pp. 172-173, 1907; and Jordan, Evermann, and Clark, *Rep. U. S. Comm. Fish. for 1928*, p. 244, 1930.

issippi to Texas are intermediate between the extreme northern and the extreme southern fish. In view of the high degree of intergradation in all the characters studied and the evident gradual change in these characters with latitude, there may seem to be good reasons for treating them all under a single heading. Nevertheless, while they do intergrade, the differences between the populations are numerous, and typical large specimens from the extremes of their geographical range may usually be identified without recourse to locality records. Also, among the species of *Hippocampus* there exists a general condition of nearness of approach or even of overlapping. The populations from the extremes of the geographic range should therefore be recognized as subspecies, *punctulatus* and *hudsonius*, the latter for the large seahorses occurring on the coast of the United States north of Florida.

Only one other species of seahorses, *regulus*, occurs within the geographic range of *hudsonius* as limited in the present paper, and it is easy to distinguish the two, *regulus* having much fewer segments and fin rays (see p. 589). *H. hudsonius* is also very near to the European species *guttulatus* and *europaeus*. The differences between them are discussed under the accounts of those species; in actual practice *hudsonius* may be distinguished from the European species by locality.

TABLE 4.—Averages of the numbers of caudal segments and fin rays of the subspecies *kincaidi*, *punctulatus*, and *hudsonius* and the populations of *hudsonius*, calculated from the frequency distributions given in table 1

Subspecies and population	Caudal segments	Dorsal rays	Pectoral rays
<i>kincaidi</i> : Bermuda.....	34.8	18.3	16.0
<i>punctulatus</i> : Florida and Cuba.....	35.9	19.3	16.4
<i>hudsonius</i> :			
North and South Carolina.....	36.5	18.6	15.8
Mississippi to Texas.....	36.7	18.7	16.1
Virginia to Maine.....	37.1	18.5	15.3

*Populations*.—While the material studied is insufficient for a thoroughgoing racial analysis, a comparison of the averages of the caudal segment and fin ray counts is highly suggestive and indicates that the subspecies *hudsonius* is composed of three distinct stocks. This is shown in table 4, which conveniently includes also the two related subspecies, *punctulatus* and *kincaidi*, for comparison. A study of table 4 together with table 3 shows that the population of *hudsonius* from the coast of North and South Carolina differs from that of Chesapeake Bay and northward in averaging fewer caudal segments, more numerous dorsal and pectoral rays, a deeper trunk, and a somewhat longer snout. The Gulf coast population, that from Mississippi to

Texas, has the caudal segments somewhat intermediate between the two foregoing populations but nearer to that from North and South Carolina, while the dorsal and pectoral ray counts diverge from the northern population to an even greater extent than the population from the Carolinas. The Gulf coast population also has a deeper trunk and longer snout than the northern population. In all these differences the two southern populations are intermediate between the northern population of the subspecies *hudsonius* and the subspecies *punctulatus*. It is evident that we are dealing here with a species consisting of at least five distinct populations, three of which may be regarded as populations of one subspecies while the other two diverge sufficiently to constitute distinct subspecies. Attention may here be called to the discussion of the geographic distribution of the species of *Hippocampus* (p. 511).

*Geographic distribution.*—The foregoing account and a study of tables 1, 3, and 4 show that the change in the structural characters is gradual with respect to latitude. Consequently, it is evident that geographically as well as morphologically an arbitrary line must be drawn between the subspecies *hudsonius* and *punctulatus*. While the most suitable boundary will need to be determined by a study of more fish from intermediate points, it seems not far fetched to assign tentatively those west of Florida as far as the Rio Grande on the Gulf coast, and those north of Florida on the Atlantic coast, to the subspecies *hudsonius* and those from Florida and Cuba to the subspecies *punctulatus*. An inspection of tables 1, 3, and 4 shows that on the whole fish from North and South Carolina and from Mississippi to Texas approach in their structural characters northern seahorses more than those from Florida and Cuba. Consequently, the geographical limits proposed are not altogether arbitrary but are based to a certain extent on morphology. The arbitrary limit suggested would also agree approximately with the general zoogeographical distribution of the boreal and tropic piscine faunas in the western Atlantic.

*Material studied.*—Off Seguin, Maine; October 1881; schooner *Charles Haskell* (38900). St. Georges Banks; G. Brown Goode (13110). Narragansett Bay, R. I.; August 13, 1880 (25792). Newport Harbor, R. I.; September 1, 1880 (26040). Off Block Island, R. I.; August 3, 1880; schooner *W. M. Goffney* (38950). Patchogue, Long Island, N. Y.; September 14, 1884 (36087). Off Long Island; lat. 40°01' N., long. 68°54' W.; surface (31876). Somers Point, N. J.; September 13, 1887; T. H. Bean (45102). Great Egg Harbor Bay, N. J., August 23, 1887; T. H. Bean (45103). Ocean City, N. J.; August 1, 1887; T. H. Bean (45104). Chincoteague, Va.; July 1913; J. B. Henderson (76979). Off Virginia, lat. 37°27' N., long. 73°33' W.; surface; October 26, 1886; *Albatross* (38189). Cape Charles City, Va.; October 1, 1897 (67885). Cape



Charles, Va. (91377, W. H. Sterling, July 22, 1897; the following three specimens taken by W. C. Schroeder in 1921: 91376, Sept. 22; 91378, Sept. 23; 91379, Nov. 23; one specimen in Bureau of Fisheries, Oct. 1894, *Fish Hawk*). Cherrystone, Va. (29108, Aug. 1881, M. McDonald; 30399, 1882, *Fish Hawk*). Britton Bay, Md.; September 29, 1911; P. Butter (77909). Potomac River, 4 miles north of Colonial Beach, Va.; summer 1915; J. J. Maxwell (73790). Hooper Island to Cedar Point, Md.; March 31, 1921; *Fish Hawk* (91375). Crisfield, Md.; August 1, 1879; T. B. Ferguson (23533). Yorktown, Va., in York River; October 11, 1921; W. C. Schroeder (91382). Old Point, Va.; Farragut (3451). Off Ocean View, Va.; September 22, 1893; *Fish Hawk*. Norfolk, Va., James Fishery; W. C. Schroeder; 1921 (91380, September 19; 91381, September 30). Off North Carolina, taken by the *Albatross* as follows: Lat.  $35^{\circ}01' N$ , long.  $75^{\circ}12' W$ .; surface, October 17, 1885 (92735); lat.  $34^{\circ}45'20'' N$ . long.  $75^{\circ}38'10'' W$ ., surface October 18, 1885 (92629); lat.  $34^{\circ}38' N$ . long.  $76^{\circ}12' W$ ., October 19, 1885 (92746); lat.  $34^{\circ}35'30'' N$ . long.  $75^{\circ}45'30'' W$ ., October 18, 1885 (93679). Beaufort, N. C.; H. C. Yarrow (15015 and 19520). Beaufort, N. C.; June 3–20, 1904; Bean and McKnew (51871 and 51872). Beaufort, N. C., several localities in vicinity; taken by staff of Fisheries Biological Station. Wilmington, N. C.; A. Ruse (92788). South Carolina coast (4316). Charleston, S. C.; steamer *McCulloch* (30728). Horn Island, Miss.; S. Springer (Field Mus. Nat. Hist. nos. 16191 and 16192). Cat Island, Miss.; S. Springer (Field Mus. Nat. Hist. no. 21605). Louisiana; H. Adam. Barataria Bay, La.; 3 specimens taken by author in shrimp trawl; November 24, 28, and 29, 1931. Harbor Island, Tex.; December 1, 1926; J. C. Pearson. Aransas Bay, Tex., near south end; in shrimp trawl; November 2, 1931; K. H. Mosher. Corpus Christi, Tex.; C. T. Reed (93595). Rio Grande, Tex.; March 20, 1883; C. M. Scammon (32558).

Total number of specimens studied, 76; 5 specimens 17 to 33 mm long; 39 specimens 43 to 150 mm long, with a brood pouch or at least a rudiment of one; 32 specimens 42 to 116 mm long, without any trace of a brood pouch.

*Synonymy*.—The name *H. laevicaudatus* has been placed by previous authors in the synonymy of *hudsonius*, and this action is followed here. There is nothing in the original description to indicate whether it refers to the present subspecies or to *punctulatus*, and the given locality, "North America", does not help to decide the question. In either case it does not affect the nomenclature, since it is a later name than either *hudsonius* or *punctulatus*. The length of the snout shown on the figure of *laevicaudatus* is more nearly like that of *hudsonius*.

## HIPPOCAMPUS HUDSONIUS PUNCTULATUS Guichenot

## FIGURES 63, 64

- Hippocampus erectus* PERRY, Arcana; or The museum of natural history, pl., May 1, 1810 ("native of the American Seas, and of the coasts adjacent to Mexico and the West Indies"; agrees most nearly with present subspecies, but may also apply to other seahorses).
- Hippocampus punctulatus* GUICHENOT, in de la Sagra's Historia física, política y natural de la isla de Cuba, vol. 4, Reptiles y peces, p. 239, pl. 5, fig. 2, 1853 (Cuba).
- Hippocampus marginalis* HECKEL, in Kaup's Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 15, 1856 (Mexico).
- Hippocampus fascicularis* HECKEL, idem (Mexico).
- Hippocampus punctulatus* DUMÉRIL, Histoire naturelle des poissons. . . , vol. 2, p. 508, 1870 (type of *punctulatus* redescribed).
- Hippocampus stylifer* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol 5, p. 265, 1882 (Florida, based on young female).
- Hippocampus punctulatus* JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 777, 1896 (*marginalis* and *fascicularis* placed in synonymy).
- Hippocampus punctulatus* EVERMANN and KENDALL, Rep. U. S. Comm. Fish. for 1899, p. 63, 1900 (Tarpon Springs, Fla.).
- Hippocampus poeyi* HOWELL RIVERO, Mem. Soc. Poey Univ. Habana, vol. 8, p. 32, fig., 1934 (off the coast of Habana in algae; probably based on specimen of present species).

*Diagnosis.*—First caudal segment nearly always hexangular (in 28), infrequently quadrangular (in one); last trunk segment always octangular; penultimate trunk segment usually septangular like the segments in front of it, sometimes novemangular (of 29 specimens examined two completely and one incompletely novemangular.) In other words, extra plates for support of dorsal normally present on first caudal and last trunk segments only, infrequently absent on first caudal and sometimes present on penultimate trunk segment (the single specimen lacking the plate on the first caudal had one on the penultimate trunk segment); or, upper ridges of trunk and tail normally overlapping on two segments, sometimes on three. Trunk segments nearly always 11 (in 28), infrequently 12 (in one, this being the same specimen having a quadrangular first caudal segment). Caudal segments usually 35 to 37, varying 33 to 37. Dorsal rays usually 19 or 20, varying 18 to 21. Pectoral rays usually 16 or 17, varying 15 to 19. Spines long or moderately long in the young fry, very conspicuous in medium-sized specimens, especially in females, usually rather well developed in adults, those on trunk sometimes nearly obsolescent in full-grown males. Coronet well developed, sometimes low in full-grown males. Trunk becoming conspicuously deep in full-grown specimens, snout rather long. Filaments usually present, sometimes profuse, often absent. General color pattern about the same as in *hudsonius*; medium-sized specimens generally with light-colored or variegated blotches around the bases of the

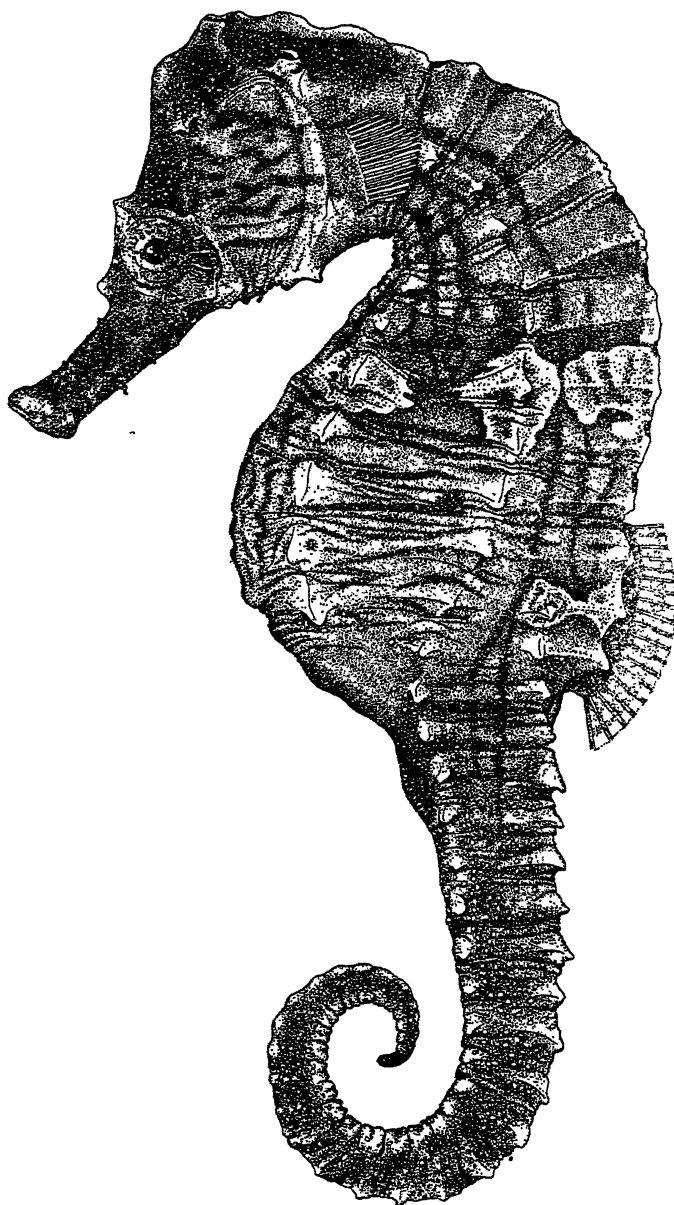


FIGURE 63.—*Hippocampus hudsonius punctulatus*, drawn from a male 107 mm long from Cuba; U.S.N.M. no. 87385. Length of specimen as drawn, 74 mm. Note the obsolescent tubercles. This seems to be characteristic of males of the Cuban population and of that from Bermuda (the subspecies *kincaidii*). In the Florida population the tubercles are usually better developed in males of the same size, and they are best developed in the northern populations (the subspecies *hudsonius*). The spots on the trunk represent an individual variation and the persistence in part of the juvenile color pattern. This variation in the adult color pattern seems to be commoner in the Cuban population but is also often present in the subspecies *hudsonius* and *kincaidii*. The spots are sometimes larger.

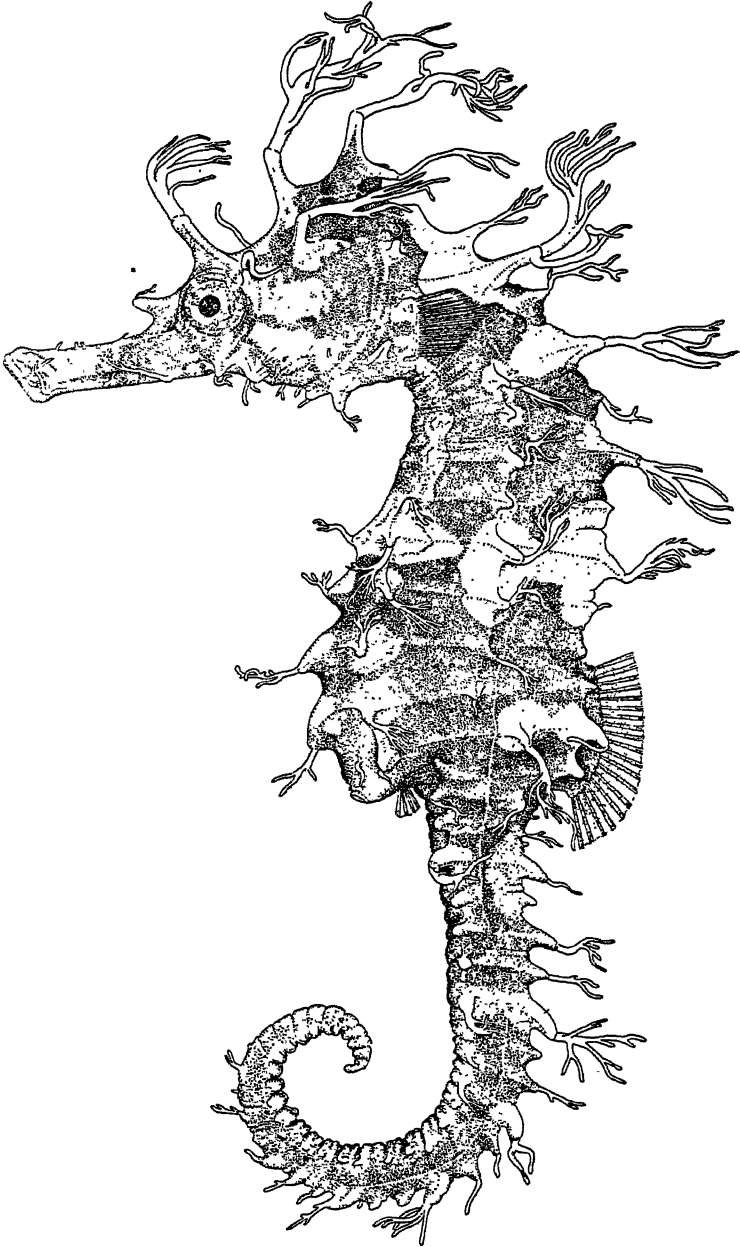


FIGURE 64.—*Hippocampus hudsonius punctulatus*, drawn from a specimen, with a rudimentary brood pouch, 91 mm long from Tampa Bay; U.S.N.M. no. 49714. Length of specimen as drawn, 63 mm. Three variations from the usual shown: (1) Spines notably longer for a specimen of its size; (2) filaments profusely developed and branched; (3) persistence in part of the juvenile spotted color pattern, shown also in figure 63, except that in this specimen the spots are not mottled. This specimen happens to show all three variations; usually they are not correlated. All three variations occur also in the subspecies *hudsonius* and *kincaidii*.

spines, against a darker background; full-grown specimens typically with narrow lines partly or wholly replacing the blotches, transverse on trunk, lengthwise on head and anterior part of the trunk, the contrasting directions of the lines usually striking along the boundary where they meet; white lines sometimes alternating with the brown lines on the opercle; bluish or whitish dots quite profuse, except on the side of the trunk, radiating rows of such dots or radiating white lines often present around eye; dorsal with a submarginal dark band. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

The variability and development of the filaments, spines, and the color pattern are quite similar to the subspecies *hudsonius*. In general, the spines are usually somewhat shorter than in *hudsonius* when specimens of approximately the same size and the same sex are compared. As in *hudsonius*, specimens sometimes have the brown lines on the trunk and head broken up into series of spots. These spots sometimes lose their rowed arrangement and such specimens approach individuals of *reidi* in color.

Four specimens were examined from Cuba. Two large males have the spines on trunk and coronet very low, almost obliterated in the largest male, 107 mm long (fig. 63), being nearly like specimens of *reidi* or *hippocampus* in this respect; but the tubercles on the tail are conspicuously better developed than in those two species. A young specimen 23 mm long also has the spines notably short for its size, strikingly shorter than in a specimen of similar size from Key West. The fourth specimen, a female 56 mm long, has the tubercles nearly as well developed as specimens of similar size from Florida. From these four specimens, therefore, it seems that the Cuban population has, on the average, the tubercles not so well developed as the Florida population. However, in the counts and measurements these four agree well with those from Florida, and the difference between the two populations apparently is of no more than racial magnitude.

*Distinctive characters and relationships.*—The relation of this subspecies to *hudsonius* has already been discussed (p. 557). Typical full-grown specimens have a strikingly different appearance from *hudsonius* on account of their deeper body, longer snout, and somewhat lower tubercles and coronet. It also has a lower average caudal-segment count and higher fin-ray count. The bluish or whitish dots are generally more profuse and more prominent, the brown lines on the head and trunk are oftener better defined, and the opercle sometimes has white lines alternating with the brown; but there is considerable intergradation between the two subspecies, as noted. The differences between this subspecies and *reidi* are discussed under the account of *reidi* (p. 575).

*Geographic distribution.*—It was suggested (p. 559) that the geographical limits of the State of Florida be arbitrarily considered as the northern geographical limit of *punctulatus*. The specimens examined from Florida represent the range from Biscayne Bay to Pensacola. South of Florida specimens were examined from Cuba. This must stand for the present as the known range of *punctulatus*, and its precise distribution remains to be determined; but in any case its geographical limits on the coast of the United States will have to be arbitrary.

Whether the seahorses from islands adjacent to Florida and Cuba are referable to *punctulatus* or to some other species or subspecies remains to be learned. Records in the literature of "*punctulatus*" from other West Indian islands or the coast of South and Central America appear doubtful or are evidently erroneous. On account of the general failure of authors to discriminate properly between the species of *Hippocampus*, it is not possible to state to which species a given record belongs unless the specimens on which the record is based are reexamined.

*Material studied.*—Biscayne Bay, Fla.; December 5, 1902; H. F. Moore (67596). Key West, Fla. (89786, Pinchot expedition, April 10, 1929, and 38689, *Albatross*, January 14, 1885; also, a very small specimen in Bureau of Fisheries collection, June 10, 1919). Off southern Florida; lat.  $26^{\circ}19'$  N., long.  $83^{\circ}33'$  W.; March 18, 1889, *Grampus* (43579). Captiva Pass, Fla.; O. P. Hay (Field Mus. Nat. Hist. no. 32829). Tampa Bay, Fla.; *Fish Hawk* (49714; 49715; 49716; 49717). Port Tampa; January 19, 1898; *Fish Hawk* (84598). Tarpon Springs, Fla. (93753, D. Melisas, April 11, 1930; also one specimen in Bureau of Fisheries, Evermann and Kendall, November 7, 1896). Off Cedar Keys, Fla.; lat.  $28^{\circ}56'$  N., long.  $82^{\circ}55'$  W.; April 3, 1887; J. F. Mosher (39361). Cedar Keys, Fla. (86117, C. R. Aschmeier; 22213; the two larger specimens in the last bottle apparently belong to *hudsonius* and may have been added later, since the register records only one specimen for that number). Pepperfish Key, *Fish Hawk* (73240). Apalachicola Bay, Fla.; shrimp trawl; June 22, 1932; collected by the author. Off Cape San Blas, Fla.; lat.  $29^{\circ}11'30''$  N., long.  $85^{\circ}29'$  W.; February 7, 1885; *Albatross* (93678). Pensacola, Fla. (30876, Jordan and Stearns, type of *H. stylifer*; 30788, S. Stearns). Cuba, near western end, obtained by Tomas Barrera expedition in 1914, as follows: Cape Cajon, submarine light, May 26 (82386); Punta Colorado, submarine light, May 21 (82385); Ensenada Santa Rosia, 23 mm, dredged in 1–3 fathoms, May 18 (82388); Esperanza (82387).

Total number of specimens studied, 29; 13 specimens with a brood pouch or the rudiments of one, 60 to 162 mm; 13 specimens without a trace of brood pouch, 49 to 142 mm; also three small specimens, 23–32 mm.

*Nomenclature and synonymy.*—The account of *H. erectus* possibly represents this subspecies, as stated on p. 517. The only relevant matters contained in that account that may be of some aid in determining what species was meant to be represented are: The depth of the trunk and the length of the snout as shown by the figure, and the size and color, which are described as “\* \* \* its size varies from seven inches to nine \* \* \*. The colour of the body is of a pale amber, shaded with brown, and which is divided into ribs transversely placed, and continued in a closer manner upon the neck and tail \* \* \*.” Of the known species occurring in the region comprised in the geographical range of *erectus* as given by Perry the description of the size and the “ribbed” color pattern, and the deep trunk and the comparatively rather long snout shown on the plate, agree most nearly with the form later described by Guichenot as *punctulatus*. The next best form to which the account approaches is *hudsonius*, with which it agrees fairly well, and if part of Perry’s material comes from the coast of the United States, north of Florida, he probably had a mixture of these forms. However, it is quite possible that Perry’s specimens represented still another species or subspecies, such as *kincaidi*. While the name *erectus* is here synonymized with *punctulatus*, I continue to use the latter name, although it was established at a later date, for two reasons: (1) It is a well-established name that has been used for this southern seahorse for three quarters of a century (remarks made on p. 516 in regard to generic name apply also to specific name); and (2) there is no means now of determining with absolute certainty what *erectus* actually represents.

There is no question that Guichenot had material of the present subspecies when he described his fish, and the name *punctulatus* belongs to it rather than to the other common West Indian seahorse, which is here designated as *reidi*. The deep body shown on the plate and the comparatively well developed spines as described and figured indicate without a doubt that the name *punctulatus* belongs to the subspecies described herewith. The spots he describes as “una mancha morena, jaspeada de blanco, de cada lado del lomo y de la base de la cola” are often developed in various positions on the trunk, and are sometimes nearly all white. These characteristic spots are often present also in the subspecies *hudsonius* and *kincaidi*. However, while characteristic of the three subspecies, these spots are more often faint or entirely absent in large specimens.

The discussion following gives the reasons for adopting the synonymy as here given. While the type of *stylifer* only has been examined, the variability of the species as worked out on the available material indicates that this synonymy is most probably correct. It has been partly suggested also by previous investigators.

*H. marginalis* and *H. fascicularis*, judged by the description of the color, were apparently based on specimens of the present subspecies. The longitudinal lines on the front part of the trunk contrasted with transverse lines posteriorly, as described for *marginalis*, is especially characteristic of *punctulatus*, although specimens often occur in which this color pattern is obscured. Substantially the same color pattern is described for *fascicularis*, but the specimen for which this name was proposed evidently had the alternating white lines on the opercle and the lower anterior corner of the trunk very prominent, which attracted Heckel's attention (see above color notes on *punctulatus* and *hudsonius*).

*H. stylifer* was based chiefly on the strong development of some of the tubercles, assuming the form of rather long spines. The type of *stylifer* is a small specimen, 55 mm long, without any trace of a brood pouch, taken in deep water, which would account for the relatively long spines, longer than usual in specimens of that size (see p. 556). It has 18 dorsal rays, not 16 as stated in the original description.

*H. poeyi*, based on a single small <sup>47</sup> female, seemingly a young specimen, is apparently another name to add to the synonyms of *punctulatus*. The counts of the segments and fin rays given in the original description distinctly fall within the range of variation of this subspecies. The figure of the type shows the spines somewhat lower than usual in females of *punctulatus* of about that size; but the development of the spines in *punctulatus* varies greatly with individual fish, some specimens assuming the adult condition when small. If the figure is correctly outlined, it may represent a young *reidi*, but it remains to be seen whether that species occurs on the coast of Cuba, and it is more likely that it is a young *punctulatus*. If *poeyi* is different from either of those two, there is nothing in the original description to show it.

Howell states in regard to his type: "Este ejemplar es cercano al *Hippocampus punctulatus* Guichenot del que difiere por las proporciones generales, la posición de la dorsal y la coloración." The position of the dorsal as shown on the figure is about that usual in *punctulatus*, and besides there is a certain degree of variation in that respect. The proportional measurements and the color vary much with individual fish and to a still more marked extent with age, the typical condition not being developed except in full-grown or nearly full-grown specimens.

<sup>47</sup> After becoming familiar with the variability and the age, sex, and specific differences shown by the species of *Hippocampus*, I think it is worse than useless to attempt to base a new species of seahorse on a single specimen, especially a juvenile, unless it shows some salient specific character; at least not until after the range of variation of closely related species is determined by a study of series of specimens of like size and in the same sex. This is true to a certain extent in other groups as well, but it is especially true of seahorses. An attempt to describe a new species of seahorse without at least a series of specimens of closely related species for comparison cannot but result, in most cases, in a distinct disservice to the cause of science.



## HIPPOCAMPUS HUDSONIUS KINCAIDI Townsend and Barbour

*Hippocampus antiquorum* GOODE (not Leach), Amer. Journ. Sci., vol. 14, p. 291, 1877 (Bermuda).

*Hippocampus kincaidi* TOWNSEND and BARBOUR, New York Zool. Soc. Bull. 23, p. 304, fig., 1906 (Bermuda).

*Hippocampus brunneus* BEAN, Proc. Biol. Soc. Washington, vol. 19, p. 32, 1907 (Bermuda).

*Hippocampus punctulatus* BEEBE and TEE VAN (not Guichenot), Zoologica, vol. 13, p. 40, 1933 (Bermuda).

*Diagnosis.*—First caudal segment hexangular (incompletely hexangular in one out of six specimens); last trunk segment octangular; penultimate trunk segment usually septangular (in five), sometimes novemangular (in one). In other words, extra plate for support of dorsal usually on first caudal and last trunk segments only, sometimes also on penultimate trunk segment; or, upper ridges of trunk and tail usually overlapping on two segments, sometimes on three. Trunk segments 11 (in all six examined). Caudal segments 33 to 36. Dorsal rays 18 or 19. Pectoral rays usually 16, varying 15 to 17. Tubercles and coronet well developed in young specimens, becoming notably low in large fish, frequently obsolescent on upper ridge of trunk in large males. Trunk of medium depth; snout of medium length. Filaments rather profuse in young, absent in the few large specimens examined. Color not well shown in the few available specimens; large whitish or variegated blotches shown on trunk of two specimens, largest specimen shows traces of transverse dark lines on trunk; white dots usually quite profuse on tail, sparse on side of trunk; general color pattern apparently the same as in *hudsonius* and *punctulatus*. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

The figure of *kincaidi* and the color description of "*brunneus*", combined with the specimens examined, make it evident that the variability of the tubercles, filaments, and color with age is approximately the same as already described for *hudsonius* or *punctulatus* (see pp. 555 and 564).

*Distinctive characters and relationships.*—The Bermuda population of this seahorse evidently forms a subspecies of equal rank with *hudsonius* and *punctulatus*. The relation between these latter two has been discussed under their accounts, and *kincaidi* may now be compared with them. The differences between the three subspecies become apparent by a study of tables 1, 3, and 4. *H. kincaidi* is characterized by a combination of characters: A low caudal segment count; the low tubercles in large males tending to become obsolescent; a trunk of medium depth; a snout of medium length; a rather low dorsal ray count; a medium pectoral ray count. In its low caudal segment count and low tubercles it is nearest to *punctulatus*, especially

to the Cuban population of that subspecies; in the depth of its trunk, the length of the snout, and the pectoral ray count it is nearest to the southern populations of *hudsonius*, while in the dorsal count it is nearest to the northern population of that subspecies. Although the number of specimens from Bermuda studied are few and the precise range of variation of this population remains to be worked out, it seems apparent that if *hudsonius* and *punctulatus* are to be recognized as subspecies, *kincaidi* also should be recognized as having equal rank with them.

In its comparatively lower tubercles, fewer caudal segments, and slenderer body *kincaidi* approaches *reidi*, and the differences between them are discussed under the latter (p. 575).

*Material studied and geographic distribution.*—Bermuda (23795, F. M. Hamlin, 1879; 23805, G. Brown Goode, 1877; also Field Mus. Nat. Hist. nos. 5064, 5065, 5066, and 5495, T. H. Bean).

Total number of specimens examined, 6; 4, with a brood pouch, 75 to 118 mm long; 2, without any trace of a brood pouch, 61 and 62 mm. Apparently *kincaidi* is now known only from the coast of Bermuda.

*Nomenclature and synonymy.*—Although the types of *kincaidi* and *brunneus* were not examined, they unquestionably pertain to the subspecies here described. Apparently the former was based chiefly on the strongly developed tubercles and their long, branched filaments, while *brunneus* was based chiefly on color, the presence of large blotches in the form of hourglasses. The present study definitely determined that in *hudsonius*, as well as in *punctulatus*, the high tubercles, the profuse filaments, and the blotches are normally juvenile characters that often persist in medium-sized or even nearly full-grown specimens (see pp. 511 and 555). Evidently the same variation occurs in *kincaidi*, although I do not have sufficient specimens to determine this definitely. The tubercles and filaments of *kincaidi* indicated on the published figure and the color of *brunneus* as described show that neither was based on specimens of *reidi*, the other large seahorse occurring at Bermuda.

Both *kincaidi* and *brunneus* were established on misapprehensions, since the characters that apparently induced their describers to establish the names are well shown by the subspecies *hudsonius* and *punctulatus* during certain stages of growth or as an individual variation. However, since the Bermuda population is subspecifically distinct from *hudsonius* and *punctulatus* on the basis of other differences, the names *kincaidi* and *brunneus*, the former having priority, are available for that population.

## HIPPOCAMPUS HIPPOCAMPUS (Linnaeus)

- Syngnathus hippocampus* LINNAEUS, *Systema naturae*, ed. 10, p. 338, 1758 (as restricted by Leach, 1814; originally a composite species).
- Hippocampus heptagonus* RAFINESQUE, *Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia*, p. 18, 1810 (substitute for *S. hippocampus* Linnaeus to avoid tautonymy).
- Hippocampus antiquorum* LEACH, *The zoological miscellany* vol. 1, p. 104, 1814 (Mediterranean only locality mentioned; substitute for *S. hippocampus* Linnaeus to avoid tautonymy; seahorses split up into more than one species and this name restricted to a Mediterranean species).
- Hippocampus brevirostris* SCHINZ, *Das Thierreich von Cuvier*, vol. 2, p. 262, 1822 (substitute for *S. hippocampus* Linnaeus to avoid tautonymy, the latter name being previously restricted by Leach to the Mediterranean species having blunt tubercles).
- Hippocampus antiquus* RISSO, *Histoire naturelle des principales productions de l'Europe méridionale*. . . , vol. 3, p. 183, 1826 (description most likely refers to present species, see p. 521).
- Hippocampus brevirostris* CUVIER, *Le règne animal*, ed. 2, vol. 2, p. 363, 1829 (name anticipated by Schinz, 1822).
- Hippocampus brevirostris* GUÉRIN-MÉNEVILLE, *Iconographie du règne animal du G. Cuvier*, vol. 2, Poiss., pl. 65, fig. 2, 1829-38.
- Hippocampus jubatus* DE LA PYLAIE, *Congr. Sci. France, Poitiers*, 1834, 2d sess., p. 528, 1835 (either a pre-Linnaean name or else a nomen nudum, see p. 524).
- Hippocampus brevirostris* RAUTHER, *Die Syngnathiden des Golfes von Neapel*, p. 8, pl. 2, figs. 11, 16, and 18, pl. 16, fig. 173, 1925 (gives also extensive account of biology and anatomy of species).

*Diagnosis*.—First caudal segment usually hexangular, often quadrangular (completely hexangular in seven, incompletely hexangular in one, quadrangular in three); last trunk segment octangular; penultimate trunk segments usually septangular like segments preceding it (in eight), often novemangular (in the three specimens having a completely quadrangular first caudal segment noted above). In other words, first caudal and last trunk segment usually with an extra plate on top; when extra plate is absent on first caudal segment it is present on penultimate trunk segments; or, upper ridges of tail and trunk overlapping on two segments, usually on the first caudal and last trunk segment, sometimes on last two trunk segments. Trunk segments 11 (in all 11 specimens examined). Caudal segments modally 35, varying 34 to 36. Dorsal rays usually 17, sometimes 16. Pectoral rays modally 14, varying 13 to 15. Tubercles low in medium-sized fish, becoming nearly obsolescent in large specimens, or at least very low and narrowly rounded above, not pointed, not abruptly stubby. Coronet rather high and blunt, bony tubercles in front of it obsolescent. Trunk deep; snout short. Filaments few, rather short, or entirely absent (highly variable as in related species shown on one of Rauther's figures, plate 16, to have many rather long and branched filaments). Color dark, numerous small brown spots of deeper intensity than ground color more or less evident, sometimes coalescing to form short lines or elongate spots on lower side

of head, often very dark all over and definite spots hardly evident; minute white dots present or absent, often coalescing to form irregular lines or a fine network, especially marked on head and to a lesser extent on trunk, often fine white lines radiating from eye. Dorsal with a whitish marginal band, underlaid by a dark brown submarginal band, basal part more or less dusky, sometimes nearly uniformly dark below marginal whitish band. (See tables 1 and 2 for counts and measurements.)

*Distinctive characters and relationships.*—*H. hippocampus* is apparently related both to *europaeus* and to *reidi*, as discussed under the accounts of those species. It has a distinctive appearance, owing to its very low or obsolescent tubercles, short snout, and rather deep body. In the low or nearly obsolescent tubercles it somewhat resembles *reidi* but differs markedly in its conspicuously deeper trunk and shorter snout and in having fewer pectoral rays, although there is a small degree of intergradation in the latter character. It may be sharply distinguished from *guttulatus*, its congener occurring in the same region with it, by a number of characters, as pointed out on page 544.

A fair percentage of the specimens tend to have the first caudal segment quadrangular. This deviation occurs less frequently in *hudsonius* and *punctulatus*, while in the subgenus *Jamsus* (see p. 584) it becomes the dominant condition. In *hippocampus* this variation is apparently correlated with a novemangular antepenultimate trunk segment.

*Material examined and geographic distribution.*—Bay of Naples, S. E. Meek, April 1897, four specimens (48325). Also seven specimens from the collection of the American Museum of Natural History, as follows: Two from the Zoological Station, Naples, Dr. Hovey (1082), and five purchased from the Zoological Station, Naples (5042) without further data. All these no doubt belong to the same species.

Total number of specimens studied, 11, 55 to 104 mm long (one specimen with the tip of the tail broken possibly somewhat larger than the longest specimen recorded here). All the specimens, except the smallest one, have a brood pouch or at least a rudiment of one. According to Rauther most of the females of this species have a brood pouch more or less developed; apparently the sexes cannot be distinguished by that character.

*Nomenclature and synonymy.*—This species has been designated most generally by the name of *brevirostris*, but the review of the literature (pp. 520 to 522) shows that that name has been proposed as a substitute for the earlier name *hippocampus*, of which it consequently becomes a synonym. In this case there is greater advantage in following the rules rather than general usage and sinking the name

*brevirostris* to synonymy, since that name was employed often to designate other species as well, such as *europaeus* and species in other parts of the globe. Furthermore, there is no possibility that the name *hippocampus* will have to be changed again. Therefore, it is a fortunate coincidence that sinking the name *brevirostris* as a synonym of *hippocampus* will serve the triple purpose of complying with the code, clearing away the existing confusion implied in the name *brevirostris*, and fixing the name of this species with finality.

*Uncertain specimen.*—A single specimen in the University of Michigan Museum (111750), found in the same lot of seahorses forming the basis of *multiannularis* (see p. 542), probably belongs to *hippocampus*. Trunk segments 11; caudal segments 37; dorsal rays 18; pectoral rays 15; first caudal segment hexangular; penultimate trunk segment septangular, tubercles nearly obsolescent. Length 102 mm, with a brood pouch; depth 18, snout 6.7, postorbital 10.5, head 20.5, trunk 30.5, tail 67.5, and orbit 4 percent of length. If these measurements are compared with table 2, it will be noted that by the length of its snout this specimen is either a *europaeus* or a *hippocampus*, but its general physiognomy is more like *hippocampus* and agrees more with the latter species in the depth of the trunk and the appearance of the tubercles. The number of caudal segments and dorsal rays falls just outside the frequency distribution of *hippocampus* as determined (compare with table 1); but it seems to fit well in that distribution as an extreme variant. If this specimen was one of the original lot from Dagry Frères (see p. 542) and came from the Bay of Biscay, it seems possible that *hippocampus*, like *guttulatus*, is represented on the Atlantic coast of Europe by a distinct subspecies. However, that remains to be determined. It is more likely that it came from the Mediterranean and represents a variant of its species with respect to the number of caudal segments and dorsal rays.

#### HIPPOCAMPUS REIDI Ginsburg

FIGURES 65, 66

*Hippocampus longirostris* KAUP (not Schinz, 1822, a French species; not Cuvier, 1829, see pp. 520 to 523 for discussion), Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 12, pl. 3, figs. 2, 2a, 1856 (Martinique and St. Lucia; recognizable figure of this species published).

*Hippocampus guttulatus* GOODE (not Cuvier), Amer. Journ. Sci., vol. 14, p. 291, 1877 (Bermuda).

*Hippocampus punctulatus* MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 255, 1923 (specimens from Porto Bello only belong to present species).

*Hippocampus reidi* GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 561, 1933 (Grenada, British West Indies; Porto Bello, Panama; Jamaica, W. I.; Haiti).

*Diagnosis.*—First caudal segment hexangular (incompletely hexangular in one out of 12 specimens examined); last trunk segment

always octangular; penultimate trunk segment usually septangular, sometimes novemangular (completely novemangular in two specimens and incompletely so in one out of 12 examined). In other words, usually first caudal and last trunk segments only with an extra plate for the support of the dorsal, infrequently missing on first caudal segment and sometimes present on penultimate trunk segment; or, upper ridges of tail and trunk usually overlapping on two segments, sometimes on three. Trunk segments normally 11 (in 11), sometimes 12 (an incomplete twelfth segment in one). Caudal segments usually 35 or 36, varying 34 to 37. Dorsal rays modally 17, varying 15 to 18. Pectoral rays usually 15 or 16, varying 15 to 17. Tubercles on upper ridge of trunk evident in small specimens (one male 46 mm long and two females 50 and 58 mm examined), but quite low, comparatively much lower than usual in specimens of *hudsonius* or *punctulatus* of similar size; in large or medium-sized specimens obsolescent or nearly obsolescent, being sometimes indicated as a slight, broadly wavelike rise (next sizes examined after the small

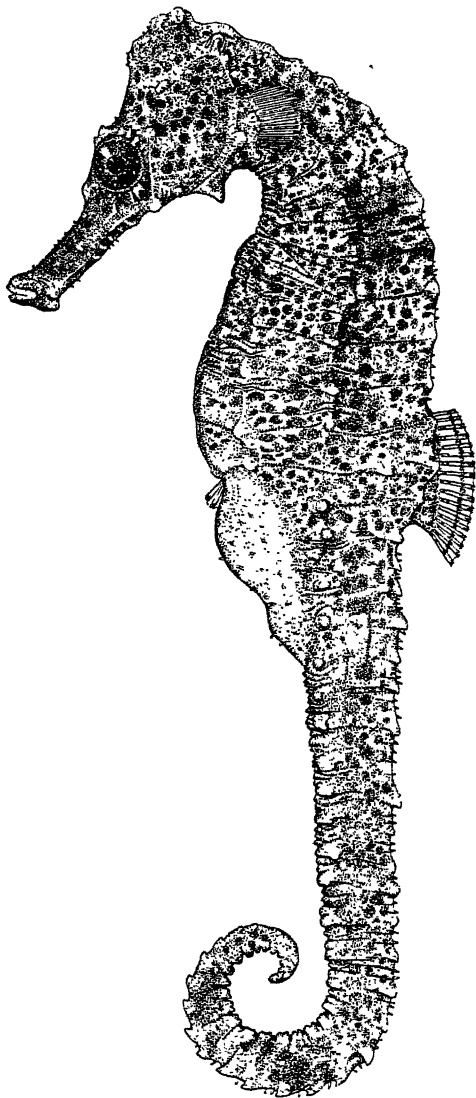


FIGURE 65.—*Hippocampus reidi*, drawn from the type, a male 121 mm long from Grenada, British West Indies; U.S.N.M. no. 86590. Length of specimen as drawn, about 91 mm.

specimens are a male 74 and a female 93 mm). Coronet medium in small and medium-sized specimens, very low in large ones. Trunks unusually slender; snout conspicuously long. Filaments absent on tubercles and coronet of large and medium-sized specimens; present

in small fish of about 50 mm long but few and short; very small tablike processes or minute pimples rather profuse and usually persistent in largest specimens, sometimes short filaments present on back (not on tubercles) of large specimens. Color pattern char-

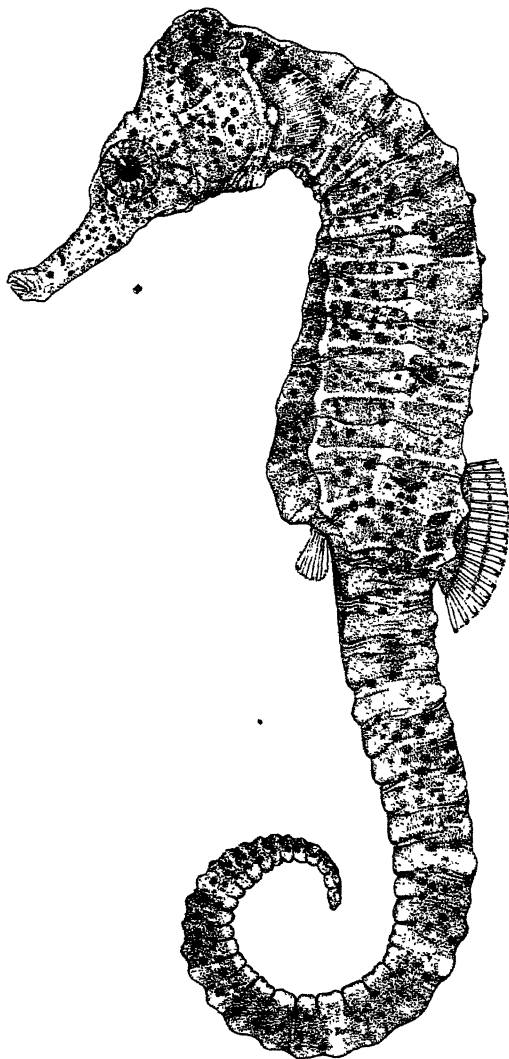


FIGURE 66.—*Hippocampus reidi*, drawn from a female 127 mm long taken with the type. Length of specimen as drawn, 89 mm.

acteristic; covered more or less thickly with small brown spots against a lighter background, the spots often differing in size, somewhat larger and more prominent spots interspersed with smaller ones, ground color sprinkled profusely with minute, almost microscopic whitish dots (color evident only in the larger specimens, the available smaller ones nearly uniformly colored without any definite color pattern, possibly faded). Dorsal hyaline with a submarginal brown streak and sprinkled at the base with small brown dots. (See tables 1 and 3 for counts and measurements.)

*Distinctive characters and relationships.*—*H. reidi* agrees most nearly with *hippocampus* from the Mediterranean in its obsolescent tubercles and number of caudal segments and dorsal rays, as well as in its color pattern, but differs sharply in having a conspicuously slenderer trunk and longer snout, while the fre-

quency distribution of the pectoral rays is quite different, although the two species overlap in that respect.

The similarity in the structure of the tubercles, the number of caudal segments and dorsal rays, and the color pattern of *reidi* and

*hippocampus* may be a case of parallelism, and it is possible that *reidi* is more nearly related to *kincaidi* and *punctulatus*. In any case, whatever is the true relationship of *reidi*, for the practical purpose of identification it is necessary to compare it with them, since its geographic range overlaps with that of *kincaidi* and possibly also with that of *punctulatus*.

Full-grown or nearly full-grown specimens of *reidi* may be sharply distinguished from *punctulatus* by their markedly slender trunk (see table 3) along with the difference in the color pattern, *reidi* being profusely spotted with small spots, while large specimens of *punctulatus* are marked generally by narrow lines or sometimes by large blotches. *H. reidi* also has the tubercles obsolescent, while in *punctulatus* they are in most specimens fairly well developed, although full-grown males sometimes closely approach *reidi* in that respect. Small specimens are not readily distinguished by depth, but may be separated on direct comparison by the difference in the structure of the tubercles, in most, but not all cases, some small specimens of *punctulatus* having the tubercles rather low. As further aids in separating the two, *reidi* has a distinctly lower dorsal fin ray count and a longer snout than *punctulatus*, but there is more or less intergradation in those two characters (see tables 1 and 3).

The present species differs from *kincaidi* in the same characters, namely, in having a slenderer trunk, obsolescent tubercles, fewer dorsal rays, a longer snout, and a different color pattern. It has been noted that *kincaidi* has a slenderer trunk and generally lower tubercles than *punctulatus*, and it consequently approaches nearer to *reidi* in those two important characters. However, to offset this convergence, *kincaidi* has a somewhat shorter snout than *punctulatus*, and it consequently diverges more from *reidi* in this character. While *kincaidi* converges toward *reidi* in the depth of the trunk, there was no intergradation in the few specimens measured (see table 3).

When all the characters are taken into consideration there should be found no difficulty in most cases in distinguishing *reidi* from *kincaidi*, as well as from *punctulatus*. At least, I did not find it difficult. It is reasonable to expect some difficulty, however, in referring occasional extreme variants of *kincaidi* and *reidi* in places where both occur, as in Bermuda. Out of seven specimens of seahorses from Bermuda available, only one may be referred to *reidi* and six to *kincaidi*, and the latter is probably the commoner seahorse on the coast of Bermuda. The single specimen of *reidi* from that coast is fortunately a nearly full-grown individual having the important characters typical of its species, and there is no question as to where it belongs.

*Material studied and geographic distribution.*—Porto Bello, Panama; Meek and Hildebrand (79685, March 19, 1912; Field Mus. Nat. Hist.



no. 8284). St. George, Grenada, British West Indies; W. O'Brien Donovan (86590, two specimens including the type). Port-au-Prince, Haiti; C. Bencomo (85958; three large specimens, dried and hence could not be accurately measured, nor the fin rays counted, but the count of the segments included in the above account; form, tubercles, and color typical of the species). Jamaica, West Indies; *Albatross*; March 1-11, 1884 (92684). Kingston, Jamaica; *Albatross*, 1884 (93732). Bermuda; G. Brown Goode; 1876-77; 1 female, 137 mm long (21933).

Total number of specimens examined, 12; 6 with a brood pouch or at least a rudiment of one, 46 to about 150 mm long (the largest male dried, and exact length cannot be determined); 6 specimens 50 to 137 mm long, without any trace of a brood pouch.

From the material examined it is evident that this species is common in the West Indies and ranges from Panama to Bermuda, but its precise geographical limits remain to be determined. Among all the available specimens from Florida and Cuba not a single *reidi* was found. Extant records in the literature, of seahorses from the West Indies, no doubt refer partly or wholly to this species, but on account of the failure of previous authors except Kaup to distinguish *reidi* it is not possible to place such records properly in the synonymy unless the specimens are reexamined. The figure published by Kaup shows the slender body, the low tubercles and coronet, and the characteristic color pattern and is readily identifiable as drawn from a specimen of *reidi*. In view of Kaup's evident failure to distinguish the species of *Hippocampus* in many cases, it is doubtful whether all his material was referable to the present species; but one of his specimens from St. Lucia and one from Martinique for which he describes the color apparently belonged to *reidi*. These two localities fall within the geographic range represented by specimens examined during my study.

#### HIPPOCAMPUS OBTUSUS Ginsburg

##### FIGURE 67

*Hippocampus obtusus* GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 562, 1933 (off Cape Hatteras, N. C.)

*Diagnosis*.—First caudal segment hexangular, last trunk segment octangular, penultimate trunk segment septangular. In other words, first caudal and last trunk segments only bearing an extra plate for the support of the dorsal; or, upper ridges of trunk and tail overlapping on two segments. Trunk segments 11; caudal segments 35; dorsal rays 17; pectoral rays 16. Every third or fourth tubercle on trunk and anterior part of tail very stout and bluntly obtuse, reduced to stout, knoblike stumps, their appearance very characteristic;

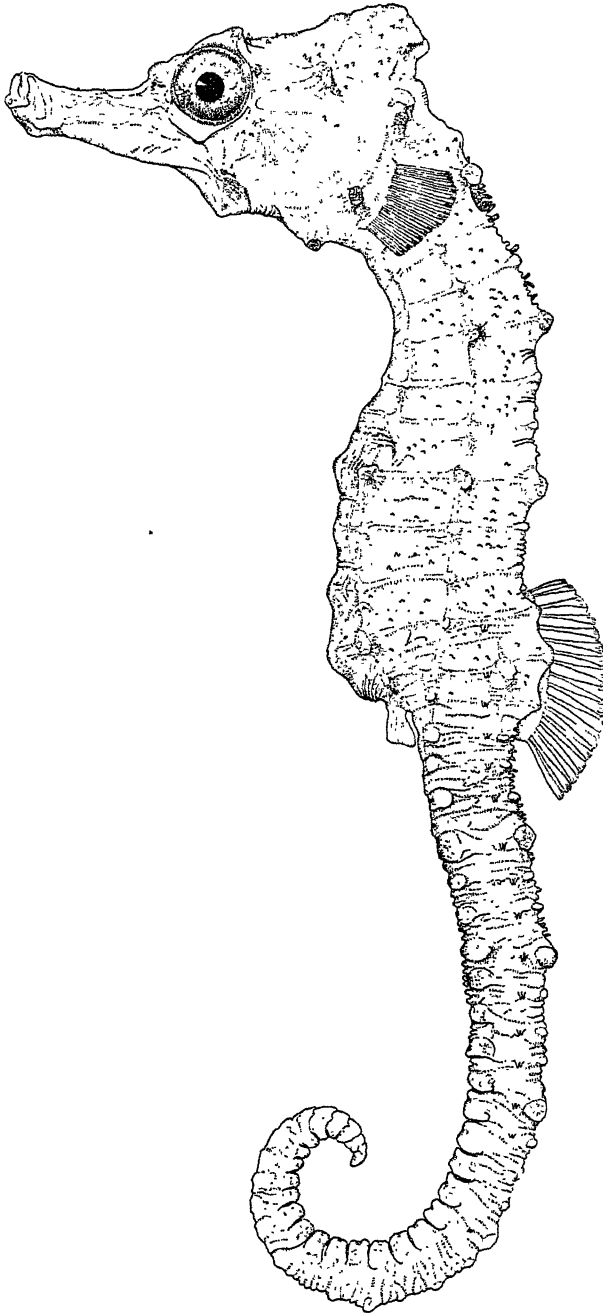


FIGURE 67.—*Hippocampus obtusus*, drawn from the type, a male 70 mm long from off the coast of North Carolina; U.S.N.M. no. 84527. Length of specimen as drawn, 55 mm.

tubercles on head, at base of pectoral, and on nape similarly stumpy. Coronet of medium height. Trunk conspicuously slender; snout rather long. First two enlarged spines on tail having short somewhat chunky stumpy appendages, no other filaments, profusely covered with pimplelike excrescences on skin; smaller on side, larger on back. Color nearly uniformly yellowish (probably faded).

*Measurements*.—Length 70 mm, with the brood pouch just beginning to develop. Depth 12, snout 10.5, postorbital 11, head 24.5, trunk 35, tail 61, and orbit 4.5 percent of length.

*Distinctive characters and relationships*.—When I first found the specimen forming the type of the present species, I immediately recognized its striking appearance and set it aside as being distinct from *hudsonius*, but I hesitated to describe it as a new species on the bare chance of its being an abnormal specimen of that species, since it was taken within the geographic range of that species and the counts of its meristic characters also fall within the range of variation of the subspecies *hudsonius*. Any doubts as to its distinctive nature were dispelled, however, after I found the three specimens from the Pacific coast that form the basis of *hildebrandi*. As later noted (p. 582), there is no question that *hildebrandi* is a distinct species. The most distinctive and striking character of *hildebrandi*—the structure of the tubercles—is nearly duplicated in the type of *obtusus*, which is evidently the Atlantic coast counterpart of *hildebrandi*, *obtusus* differing chiefly in its fewer caudal segments and dorsal rays.

*H. obtusus* differs from the other species occurring within its geographic range, *hudsonius*, as well as from all other American species except *hildebrandi*, chiefly in the structure of the tubercles, which is very striking. It is one of those characters hard to describe but may be appreciated fully by direct comparison of material. The tubercles in *obtusus* are very stout and blunt, but they are also low, being reduced to mere stout blunt stumps or knobs. They are unlike the rather slender and notably higher tubercles of *hudsonius*, or the more or less obsolescent tubercles of *hippocampus* and *reidi*. *H. obtusus* differs further from *hudsonius* in having a notably slenderer trunk and a longer snout, more so than even the extreme variants of *hudsonius* of similar size (compare with table 3). The paucity of specimens of *obtusus* in collections, only the type being known, may possibly be explained by its probable offshore habitat, as discussed in the next paragraph.

*Material studied and distribution*.—Off Cape Hatteras, N. C.; *Albatross*; June 5, 1885 (84527, the type); the only known specimen. This species possibly has more of an offshore habitat, while *hudsonius* is common in shallow water inshore and is also taken offshore. There are no available data as to the habitat of the type, but on the day on which it was captured the *Albatross* was engaged in line fishing

offshore in 50½ to 123 fathoms.<sup>48</sup> While this fact is suggestive, it is not conclusive. It may have been taken at the surface either offshore or inshore. The vertical as well as the geographical distribution of this species remains to be determined.

HIPPOCAMPUS HILDEBRANDI Ginsburg

FIGURES 68, 69

*Hippocampus ingens* MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 256, 1923 (three specimens from Chame Point, Pacific coast of Panama, referred to the present species).

*Hippocampus hildebrandi* GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 562, 1933 (Chame Point, Panama, based on specimen of preceding record).

*Diagnosis.*—First caudal segment hexangular; last trunk segment octangular; penultimate trunk segment septangular, sometimes novemangular (in one specimen out of three penultimate trunk segment incompletely novemangular). In other words, extra plate for support of the dorsal usually present on first caudal and last trunk segment only, sometimes also on penultimate trunk segments; or, upper ridges of tail and trunk usually overlapping only on two segments. Trunk segments 11, caudal segments 39 (same count in all three specimens examined). Dorsal rays 20 (in two) or 21 (in one). Pectoral rays 16 (in one) or 17 (in two). Tubercles on upper ridge not at all pointed, every third or fourth strikingly stout but low, forming characteristic stout, blunt, knoblike stumps (very similar in appearance to those of *obtusus*). Coronet well developed, of medium height. Trunk slender; snout rather long. No slender filaments, but fleshy, short appendages present on some tubercles; profusely covered with pimplelike projections. The three available specimens nearly uniformly dark, without any well-marked color pattern; sometimes with small brown spots irregularly scattered on opercle, trunk and tail. Rays of dorsal dark brown at bases gradually becoming lighter distally; a narrow, longitudinal hyaline streak, a little below middle, interrupting the conspicuous brown color on the rays; interradiat membrane hyaline.

*Measurements.*—Two, without a brood pouch, 46 and 68 mm long; depth 12 and 13.5, snout 10 (in both), postorbital 11.5 and 10.5, head 25 and 24.5, trunk 31.5 and 30, tail 63.5 and 65.5 and orbit 6 and 4.5 percent of length, respectively; one with a rudimentary brood pouch 49 mm, depth 9, snout 10, postorbital 11, head 25.5, trunk 32, tail 61.5, and orbit 6 percent of length.

*Distinctive characters and relationships.*—The three specimens forming the basis of the foregoing account unquestionably represent a distinct species. There is only one other species, *ingens*, now known from the Pacific coast of Panama, and *hildebrandi* should be compared

<sup>48</sup> Rep. U. S. Comm. Fish. for 1885, p. 80, 1887.

with that. The two have approximately the same number of segments and fin rays (compare with table 1). Hence, it may be suggested that *hildebrandi* represents the young of *ingens*, but it is evident

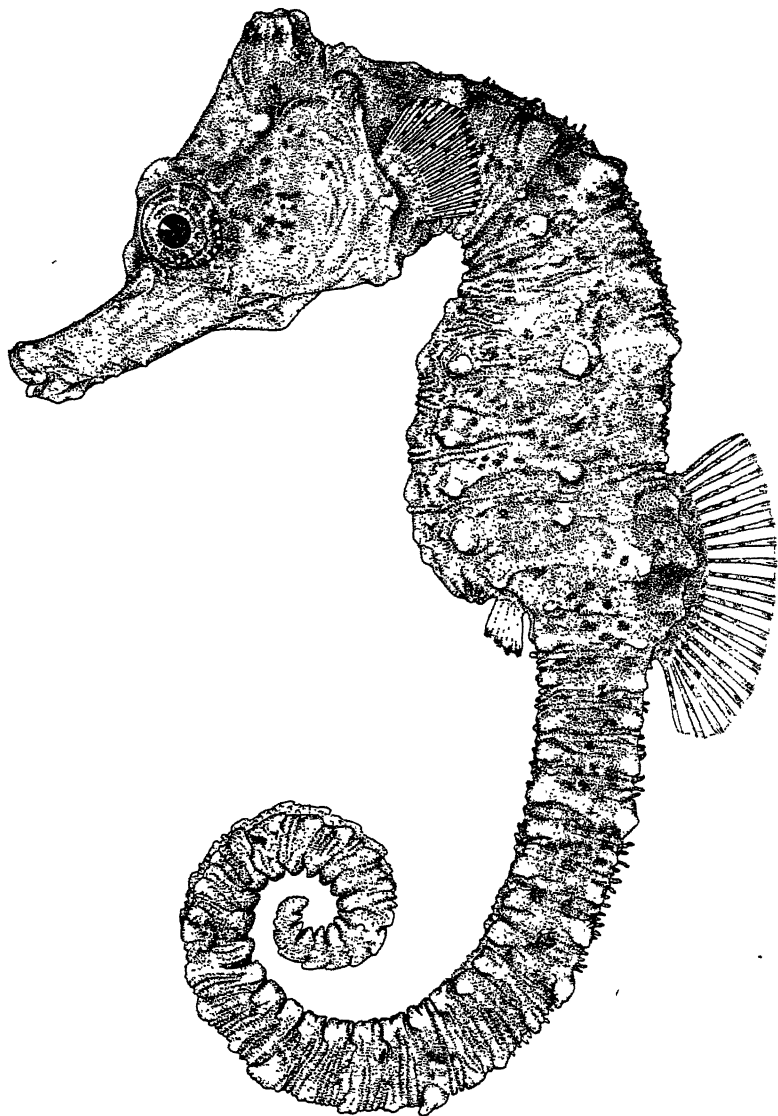


FIGURE 68.—*Hippocampus hildebrandi*, drawn from the type, a female 68 mm long from the Pacific coast of Panama; U.S.N.M. no. 82036. Length of specimen as drawn, 39 mm.

that such is not the case, although I did not have specimens of the same size in both species for comparison. In the species of *Hippocampus* examined by me, the tubercles are notably better developed

and pointed in smaller fish. This is the invariable rule in all the species examined (except possibly *obtusus* and *hildebrandi* for which no

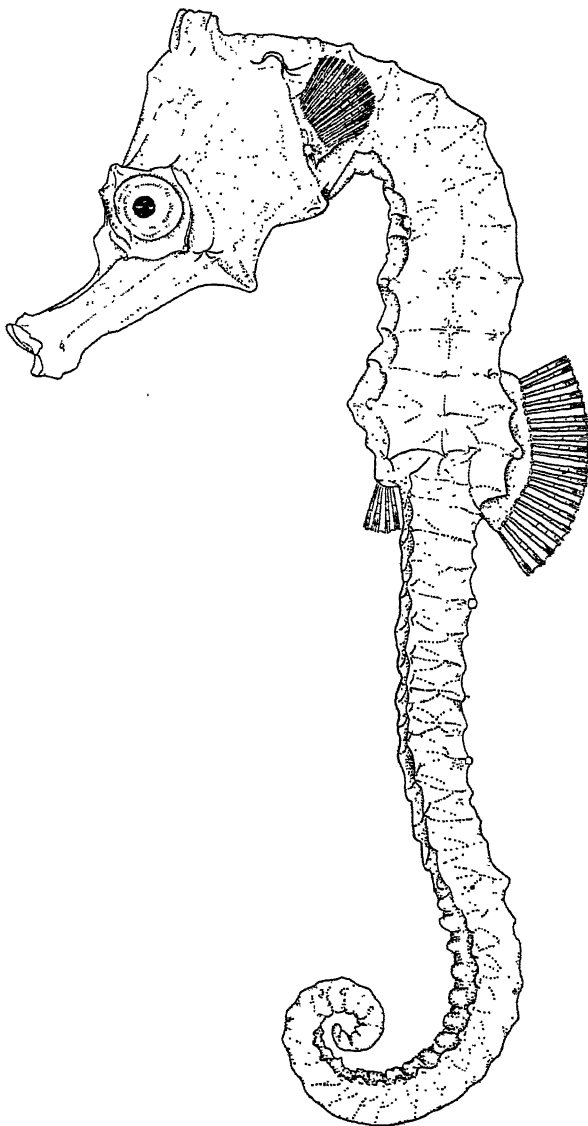


FIGURE 69.—*Hippocampus hildebrandi*, drawn from a male 49 mm long; U.S.N.M. no. 82039. Length of specimen as drawn, 35 mm. Note the very rudimentary tubercles in a male of this size, although in other species the tubercles are well developed in such small specimens. A smaller female, 46 mm long, U.S.N.M. no. 82037, has the tubercles better developed but stumpy, essentially as in figure 68.

series of specimens in graduated sizes are available), and is also true of *ingens*. The smallest available specimen of *ingens* is 113 mm long and the largest 201 mm. The tubercles in *ingens* are notably better devel-

oped in the smaller specimens, being distinctly higher and spinous, as in the other species of *Hippocampus*, while in the three specimens here assigned to *hildebrandi* the tubercles are much broader and lower, although these three are considerably smaller than the smallest specimen of *ingens* examined. The difference in appearance is very striking, but it is hard to convey an adequate verbal picture, and this difference may be appreciated fully only by a direct comparison of material. After familiarity is gained with the change in the appearance of the tubercles on account of growth in the species of *Hippocampus*, a comparison between the available specimens of *ingens* and *hildebrandi* will force the conclusion that they represent distinct species. *H. hildebrandi* is evidently most nearly related to *obtusus* from the Atlantic coast, differing sharply in having more caudal segments and dorsal rays.

*Material examined and distribution.*—Chame Point, Pacific coast of Panama; Robert Tweedlie (82037; 82039; 82063, the type); two specimens, 46 and 68 mm long without any trace of a brood pouch, 1 specimen 49 mm long with a rudimentary brood pouch.

All three specimens were captured by Robert Tweedlie, whose methods of collecting are described by Meek and Hildebrand,<sup>49</sup> as follows: “\* \* \* most of his specimens were either dipped up by the sand dredge \* \* \* or taken with the dip-net \* \* \* in the vicinity of the dredge. \* \* \* the position of the dredge \* \* \* was located at the end of Chame Point, a long and very narrow neck of land projecting a distance of about thirty miles into the sea.” Therefore, it is possible that this species has an offshore habitat as was discussed for its close relative *obtusus* (p. 578). A fourth specimen obtained by Tweedlie is a true *ingens* and was included in the account of that species. The two Pacific coast species, therefore, apparently overlap in their ranges, even though they may be found to differ in their vertical distribution.

#### HIPPOCAMPUS VILLOSUS Günther

*Hippocampus villosus* GÜNTHER, Zoology of the voyage of H.M.S. *Challenger*, vol. 1, pt. 6, Fishes, p. 8, pl. 1, fig. D, 1880 (off Bahia).

*Hippocampus punctulatus* MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 255, 1923 (the specimen from Fox Bay, Colon, Panama, here referred provisionally to *villosus*.)

*Diagnosis.*—First caudal segment hexangular, last trunk segment octangular, penultimate trunk segment septangular like the segments preceding it. In other words, an extra plate for the support of the dorsal on last caudal and first trunk segments only; or, upper ridges of tail and trunk overlapping on two segments. Trunk segments 10; caudal segments 34; dorsal rays 16; pectoral rays 15. Tubercles on upper ridge of trunk well developed and pointed. Coronet high.

<sup>49</sup> Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 6, 1923.

Trunk deep; snout of medium length. Filaments short, more or less branched, present on spines of head and of upper ridge of trunk and anterior part of tail. Brown, with lighter blotches around bases of spines of trunk, the blotches coalescent (the color pattern somewhat as in specimens of *hudsonius* or *punctulatus* of similar size); white dots present, but scanty; dorsal with obliquely longitudinal rows of rather faint brownish spots near base, no submarginal band.

*Measurements.*—Length 68 mm, without any trace of a brood pouch; depth 17, snout 8.5, postorbital 12, head 24, trunk 38, tail 56.5, and orbit 4.5 percent of length.

*Distinctive characters and relationships.*—The foregoing account is based on a single specimen that I refer with considerable doubt to Günther's species, which is also known from but one specimen. The species of *Hippocampus* are so variable intraspecifically, and so closely approaching or even overlapping interspecifically, that it seems foolhardy to base a species on a single specimen, except where it shows some salient character unmistakably distinguishing it. There must be even greater uncertainty to attempt to identify a single specimen with a poorly established species without comparing it directly with the type. However, this specimen is evidently of a different species from any of the others from the American coasts described in the present paper, and it agrees fairly well with the inadequate account of *villosus*, except that Günther's specimen apparently had a longer snout. Not wishing to establish a new species on a single specimen in this case, I provisionally refer it to *villosus*.

Judged from the species from the American coasts known at present, this specimen belongs to a species nearest to *reidi* on one hand and to *punctulatus* on the other, but it apparently differs from both. The most striking feature is its relatively small number of segments, both trunk and caudal segments. The 10 trunk segments represent the most usual number found in the subgenus *Jamsus*. Of the other species described herein, only one specimen of *hudsonius*, out of 76 examined, had this number, while in all the rest of the species not one specimen was found with 10 trunk segments. It is possible that the specimen here referred to *villosus* represents a rare variant, but the probabilities are much more strongly in favor of its representing a species that normally has fewer trunk segments. The number of caudal segments is also near to the normal condition in the subgenus *Jamsus*, but it also falls at the extreme of the frequency distributions of *reidi* and *punctulatus* (compare with table 1). This specimen further differs from *reidi* in its deeper body and strikingly better developed tubercles, and from *punctulatus* in having a deeper body when specimens of approximately the same size are compared (see table 3). From the two species belonging to the subgenus *Jamsus* it differs



strikingly in its larger size and also in having more numerous dorsal and pectoral rays.

*Material studied.*—Fox Bay, Colon, Panama; Meek and Hildebrand; March 25, 1911 (81727); one specimen without any brood pouch.

JAMSUS, new subgenus

*Genotype.*—*Hippocampus regulus* Ginsburg.

*Definition.*—Dorsal rays 10 to 14. Pectoral rays 10 to 12. Trunk segments usually 10, often 9, infrequently 11. Caudal segments 28 to 34. Upper ridges of tail and trunk usually overlapping on one segment, sometimes on two, rarely on none; usually on last trunk segment, often on first caudal. First caudal segment usually quadrangular; last trunk segment usually octangular (last trunk and first caudal segments often both hexangular in *zosteræ*, in those specimens having nine trunk segments, see p. 590). Penultimate trunk segment, like the segments in front of it, usually septangular, infrequently novemangular. Base of dorsal on two segments, usually on last two trunk segments, often on last trunk and first caudal segments. Size notably small.

*Relationships.*—*Jamsus* is evidently related to the typical subgenus but differs from it chiefly in having fewer fin rays, fewer trunk and caudal segments, and normally one instead of two extra plates for the support of the dorsal. In the number of dorsal and pectoral rays there are no intergradients between the two subgenera in the species studied. *Jamsus* contains two species, which are notably small in size, and their smaller size is correlated with a lesser number of fin rays and segments.

*Etymology.*—An arbitrary combination of two Biblical Hebrew words: jam<sup>50</sup>=sea, and sus<sup>51</sup>=horse, nouns in masculine gender according to the rules of Hebrew grammar; transliterated into the Latin alphabet according to the rules of the Library of Congress,<sup>51</sup> except that the Hebrew letter "yod" is rendered into "j", equivalent to the old Latin consonantal "i"; the "j" pronounced like the English "y".

HIPPOCAMPUS REGULUS Ginsburg

FIGURES 70, 71

*Hippocampus regulus* GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 563 1933 (Mississippi; Texas; Campeche, Mexico).

*Diagnosis.*—First caudal segment nearly always quadrangular (incompletely hexangular in one out of 24 specimens examined), last trunk segment always octangular, penultimate trunk segment nearly

<sup>50</sup> See, for instance, Exodus 15:1.

<sup>51</sup> See also Funk & Wagnalls Jewish Encyclopaedia, vol. 2, p. ix.

always septangular (incompletely novemangular in one out of 24 specimens). In other words, an extra plate for support of the dorsal normally on last trunk segment only, infrequently also on first caudal or penultimate trunk segment (on one side only of each one of two specimens out of 24 examined); or, upper ridges of tail and trunk normally overlapping on one segment only (with the exception noted). Trunk segment 10 (in 23), sometimes 9 (in one specimen from Campeche). Caudal segments usually 29 to 31, varying 28 to 32. Dorsal rays modally 11, varying 10 to 12. Pectoral rays modally 11, varying 10 to 12. Base of dorsal on last two trunk segments. Tubercles on upper ridge fairly well developed and pointed, sometimes low in full-grown males. Coronet comparatively high. Filaments usually present, relatively not long, their numbers varying greatly with individual fish and to some extent with age, sometimes profuse and more or less branched, often absent or nearly absent, especially in full-grown specimens; minute pimples usually profuse. Color variously mottled with yellowish of contrasting intensity or with brownish, without any definite color pattern; basal two-thirds of dorsal with lengthwise rows of small diffuse spots, often more or less coalescent, forming a diffuse network, sometimes nearly uniformly pigmented but increasingly darker proximad; sometimes with a distinct submarginal dark band, sometimes nearly hyaline. (See table 5 for counts.)

*Measurements.*—A male, 30.5 mm long, depth 18.5, snout 7, postorbital 12, head 22.5, trunk 34, tail 62.5, and orbit 6 percent of length. A female, 26.5 mm long, depth 17, snout 8.5, postorbital 13, head 25.5, trunk 36.5, tail 55.5, and orbit 7.5 percent of length.

*Distinctive characters and relationships.*—This species is evidently closely related to *zosteræ*. The greatest divergence is in the number of dorsal rays, although there is a certain degree of intergradation between the two species (see table 5). There is also a decided divergence in the number of caudal segments, but the intergradation in that character is even more pronounced than in the number of dorsal rays.

The individuals comprising the species *regulus* seem, from the material examined, to form a comparatively homogeneous and compact mass with reference to their structure, shown especially by the relative stability in the number of trunk segments and the almost constantly quadrangular first caudal segment. Of the 24 specimens examined only one from Campeche has nine trunk segments, and only one from Cat Island has an incompletely hexangular first caudal segment. The specimens from Campeche otherwise differ but slightly from those of the northern coast of the Gulf. The frequency distributions of the fin rays in the Campeche lot correspond exactly to

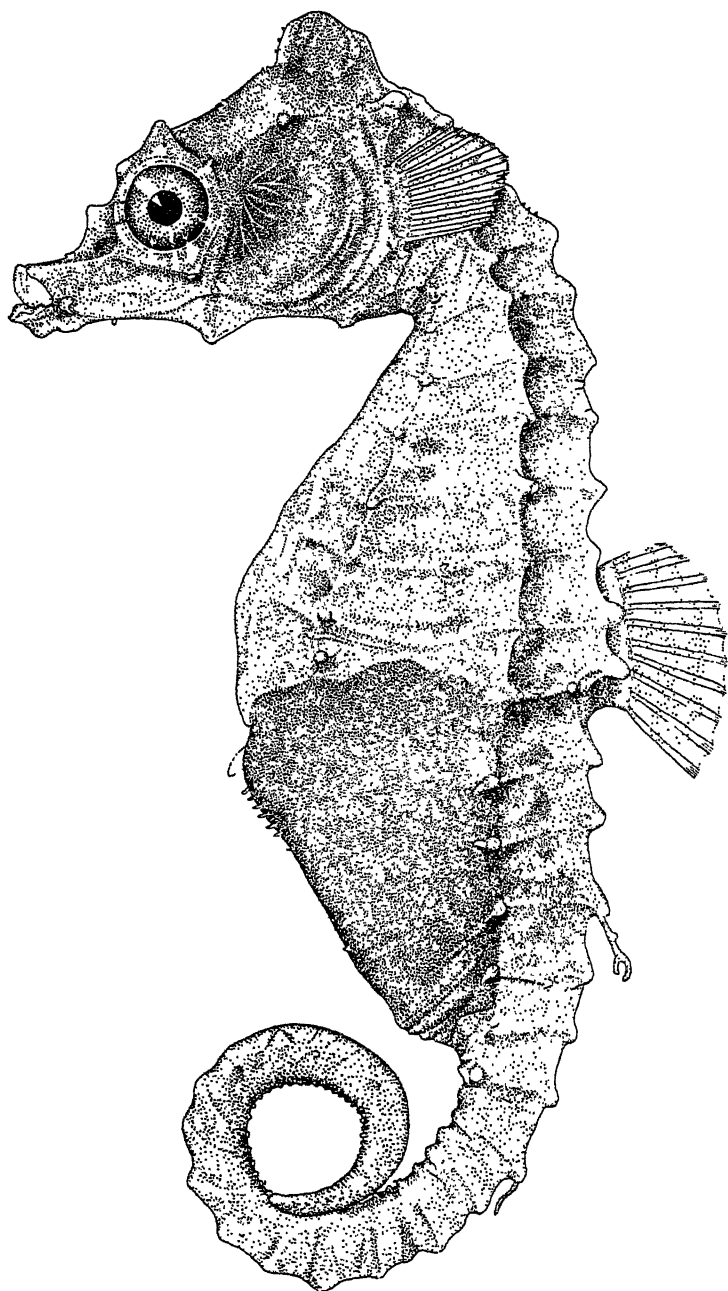


FIGURE 70.—*Hippocampus regulus*, drawn from the type, a male 30.5 mm long from Harbor Island, Tex.; U.S.N.M. no. 92950. Length of specimen as drawn, 19.5 mm.

those from Mississippi and Texas. The number of caudal segments is also nearly the same, averaging slightly greater in the Campeche lot, but this slight difference may disappear when more specimens

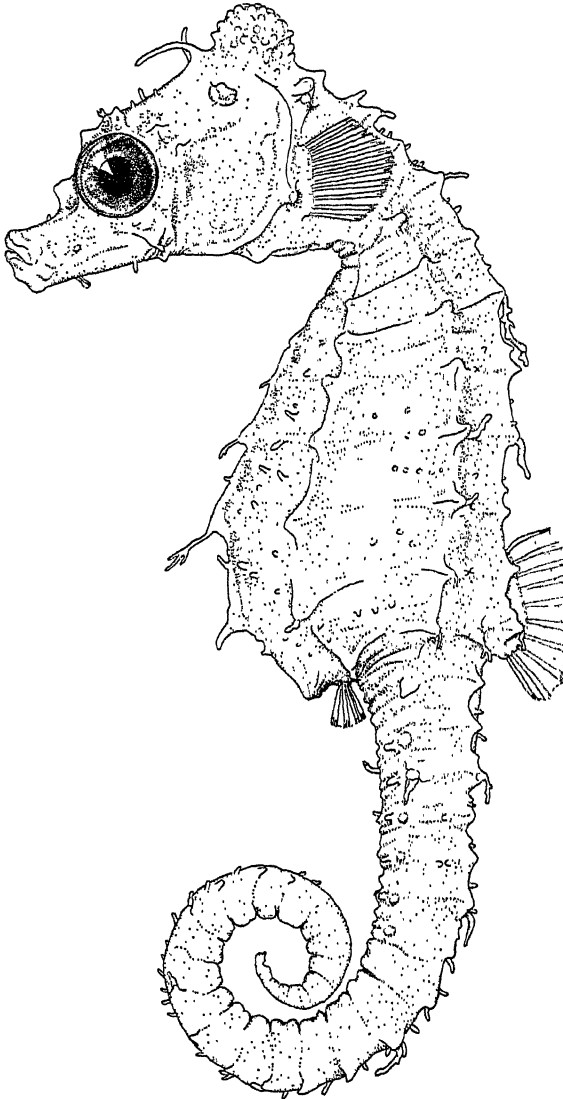


FIGURE 71.—*Hippocampus regulus*, drawn from a female 29.5 mm long from Harbor Island, Tex. Length of specimen as drawn, 17.5 mm.

are examined. The presence of these two variants in a widely separated population emphasizes the relative homogeneity of *regulus* and is in strong contrast to the high degree of variability shown by

*zosteræ*, which tends to break up into distinct stocks as discussed hereafter (p. 592).

Of the two variants of *regulus*, the one with the nine trunk segments has a quadrangular first caudal, while the one with an incompletely hexangular first caudal segment has 10 trunk segments. It will be shown (p. 591) that in *zosteræ* nine trunk segments are always correlated with a hexangular first caudal segment. In *regulus* these variations are not only infrequent but when they do occur they are not correlated. Another point of considerable interest is that *regulus*, in two important characters—number of trunk segments and number of pectoral rays—approaches much more the Key West population of *zosteræ* than its Pensacola population (see table 5).

There are legitimate grounds for difference of opinion in regard to the taxonomic status of *regulus*, whether it is to be considered as a full species or as a subspecies. According to the data presented, it may be regarded, within reason, as a subspecies of *zosteræ*. However, while the degree of intergradation in the characters investigated is greater than usual between distinct species of fishes in general, it is also of a lesser degree than the usual intergradation between subspecies of fishes. Furthermore, speciation in the genus *Hippocampus* is quite unlike that usual among fishes. A condition of very near approach or even of overlapping is evidently normal in *Hippocampus* (see, for instance, discussion of relationship of *ingens*, p. 536). A comparison between tables 1 and 5 shows that the divergence between *regulus* and *zosteræ*, in the number of dorsal rays and caudal segments, is much more pronounced and of a much higher degree than that between the subspecies *hudsonius* and *punctulatus*, for instance. It was also shown that *regulus* is nearer to the Key West population of *zosteræ*, whereas if *regulus* were a mere geographical subspecies of *zosteræ*, it would be reasonable to expect it to differ in a regular latitudinal direction and to be nearer the Pensacola population of *zosteræ*. All available evidence considered, therefore, it seems best to assign full specific rank to *regulus*, although this opinion may have to be changed by a study of more material and specimens from intermediate localities.

As compared with all other American species of *Hippocampus* except *zosteræ*, *regulus* is readily distinguished by the number of trunk and caudal segments, the number of fin rays, and its small size.

*Material studied and geographic distribution.*—Cat Island, Miss., collected by the author November 15, 1931. Harbor Island, Tex., J. C. Pearson (92950, the type, May 1927; also in the Bureau of Fisheries, collected on the following dates: 1 specimen with the type; 2 on April 3, 1927, 1 on October 20, 1926, 2 on October 25, 1926, 2 on November 12, 1926). Hog Island, Tex.; J. C. Pearson. Champoton,

Campeche, Mexico, A. S. Pearse; July 13, 1932 (Univ. Michigan Mus. no. 102819).

Total number of specimens studied, 24; 13, with a broad pouch or at least a rudiment of one, 21 to 34 mm long; 11, without any trace of a brood pouch, 17 to 30 mm long. Some of the larger specimens have the brood pouch fully developed. Judged by the material examined, the maximum size attained by *regulus* is considerably below that of *zosteræ*. All the specimens I obtained at Cat Island were picked out from seaweed landed by a small drag seine in shallow water on a sandy shore.

TABLE 5.—Frequency distribution of some meristic characters of *Hippocampus zosteræ* and *regulus* according to locality

Species and locality	Dorsal rays					Caudal segments								Trunk segments :			Pectoral rays		
	10	11	12	13	14	28	29	30	31	32	33	34	9	10	11	10	11	12	
<i>zosteræ</i> :																			
Biscayne Bay.....			2						1		2	2	2	3			1	1	
Key West <sup>1</sup> .....		4	11	5					4	11	4	1	4	16	1		12	9	
Captiva Pass.....			16	2				1	2	7	6	1	5	12	1	3	6	9	
Pensacola <sup>2</sup> .....		2	9		1				2	6	4		7	6		1	4	8	
<i>regulus</i> :																			
Mississippi and Texas.....	2	15	1			1	6	6	4	2				19		4	12	2	
Campeche, Mexico.....		5						2	2	1			1	4		1	4		

<sup>1</sup> Including four specimens from Newfound Harbor Key.

<sup>2</sup> Including one specimen from Apalachicola.

<sup>3</sup> Two specimens from Captiva Pass and two from Pensacola had 10 incomplete trunk segments and are included with the others having 10 segments.

#### HIPPOCAMPUS ZOSTERÆ Jordan and Gilbert

*Hippocampus zosteræ* JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 5, p. 265, 1882 (Laguna Grande, Pensacola, Fla.)

*Hippocampus zosteræ* BEAN, U. S. Nat. Mus. Bull. 27, p. 430, 1883 (Pensacola, Fla.).

*Hippocampus rosamondæ* BORODIN, Bull. Vanderbilt Oceanogr. Mus., vol. 1, art. 1, p. 16, pl. 1, fig. 3, 1928 (Cuba).

*Diagnosis*.—First caudal segment usually quadrangular, very often hexangular; last trunk segment usually octangular, often hexangular (when last trunk segment is hexangular the first caudal in the same specimen is also usually hexangular); penultimate trunk segment nearly always septangular (incompletely novemangular in two out of 59 specimens examined). In other words, usually only one extra plate for the support of the dorsal, in most cases on the last trunk segment, often on the first caudal segment, infrequently two extra plates (on one side only of the two specimens noted); or, upper ridges of trunk and tail overlapping on one segment, infrequently on two, rarely on none (in one out of 59 examined, this specimen being without extra plates). (The variation in the structure of the first caudal

segment is closely correlated with the variation in the structure of the last trunk segment and the number of trunk segments. The frequency of occurrence of these variations differs with the local stock. These points are discussed below.) Trunk segments usually 10, often 9, sometimes 11. Caudal segments usually 31 to 33, varying 30 to 34. Dorsal rays modally 12, varying 11 to 14. Pectoral rays 10 to 12. Tubercles usually quite conspicuous, often becoming very low in full-grown males. Coronet comparatively high. Trunk rather deep; snout usually quite short. Presence of filaments varying with the individual and evidently also with age, oftener absent, the specimens having filaments usually belonging to the smaller size groups, filaments when present relatively short, often branched. Color variously mottled with contrasting yellowish shades, often with white and brown, without any definite color pattern, sometimes quite dark all over, sometimes with whitish cross bands on tail; dorsal with a submarginal brown streak typically present, usually with one or two rows of diffuse spots at the base; often entire fin nearly colorless. (See table 5 for counts.)

*Variability in structure of region where trunk and tail meet, and its correlation.*—*H. zosteræ* shows two main trends of variation which are correlated with locality to a considerable extent. In the majority of specimens of the entire available lot representing all localities, the first caudal segment is quadrangular and the last trunk segment octangular. All such specimens have the single extra plate on the last trunk segment, while the dorsal is situated on the last two trunk segments and the number of trunk segments is 10, infrequently 11. Very often the following important variation in structure occurs: The first caudal segment is hexangular, and the last trunk segment is also hexangular; in other words, the extra plate is on the first caudal instead of on the last trunk segment. In all such specimens the base of the dorsal is situated over the last trunk and first caudal instead of over the last two trunk segments, and the number of trunk segments is 9 instead of 10.

This latter variation may be easily conceived as having been derived from the former by the last trunk segment losing the last lowermost point of intersection and thus having changed to a caudal segment. The probability that this is the correct explanation is increased by the fact that in *regulus*, the near relative of *zosteræ*, the former condition is normal for the species almost without any exception. Furthermore, four specimens of *zosteræ* out of 59 examined are asymmetrical, one side of the fish showing one of the two general variations described and the other side showing the other variation, the probable manner in which the change occurs thus being shown by the same individual fish (see p. 592). In other words, in *zosteræ* there is a very decided

tendency for the last trunk segment to change to a caudal segment by the loss of the last point of intersection on the lower lateral ridge. As a result the number of trunk segments is reduced by one; the first caudal, instead of the last trunk segment, now bears the extra plate for the support of the dorsal, and the base of the dorsal is placed over the last trunk and first caudal segments instead of over the last two trunk segments. This important trend of evolution shown by a comparatively large percentage of specimens evidently indicates a more recent development. The frequent presence of a hexangular caudal segment in this species may appear to show a more primitive condition, since this occurs also in the subgenus *Hippocampus*. However, in *zosteræ* a hexangular caudal segment is correlated with a hexangular last trunk segment, and the latter condition, in its turn, is unique and apparently represents a more recent development. Consequently, the hexangular first caudal segment in *zosteræ* probably represents a pseudoreversion and not a primitive condition; that is, it is caused by the last trunk segment changing to a caudal segment as a consequence of a shortening of the lower ridge on the trunk. The evidence strongly favors the conclusion that *zosteræ* is now undergoing a gradual change, which, if carried far enough, will result in the formation of a distinct species, or even subgenus, having nine trunk segments. The tempo of the change evidently differs with the population (see p. 592).

For convenience, the individual variability, besides the main trends of variation, may be indicated as follows: Altogether 59 specimens were examined, in which the number of trunk segments were: 19 with 9 complete segments; 34 with 10 complete segments; 4 with 10 incomplete segments; and 2 with 11 complete segments. Of those having 9 segments 14 have an extra plate on the first caudal segment only; three have an extra plate on the last trunk and first caudal segments; in one an extra plate is present only on one side of the first caudal segment; and in one an extra plate is present only on one side of the last trunk segment and on both sides of the first caudal segment. Counting the variants showing asymmetry as though they were bilaterally symmetrical, and combining the above figures, we get 15 specimens having an extra plate on the first caudal segment only and four having extra plates on the last trunk and first caudal segments. These figures consequently show that nine trunk segments are always correlated with a hexangular first caudal segment and decidedly correlated with a hexangular last trunk segment. Of the 34 specimens having 10 trunk segments, 30 have an extra plate on the last trunk segment only; one has an extra plate on one side of the penultimate trunk segment on both sides of the last trunk segment and none on the first caudal; one has an extra plate on one side only of the last trunk segment and on both sides of the first caudal



segment; one has an extra plate on both sides of the last trunk and first caudal segments; one lacks extra plates (this being the only one of all the specimens examined, including all the species, which entirely lacked extra plates for the support of the dorsal). Again combining the specimens showing asymmetry with the others, as above, omitting the specimens entirely lacking plates, and not taking account of the extra plate on the penultimate trunk segment of one specimen, we get 31 specimens having an extra plate on the last trunk segment only and two having extra plates on the last trunk and first caudal segments. Consequently, these figures show that 10 trunk segments are nearly always correlated with an octangular last trunk segment and nearly always with a quadrangular first caudal segment.

The two specimens with 11 trunk segments have an extra plate on the last trunk segment only, like the dominant condition in those specimens having 10 trunk segments.

Four specimens, two from Pensacola and two from Captiva Pass, have 10 trunk segments with the last one incomplete (see p. 504 for explanation of an incomplete trunk segment). Each one of these four has the extra plate on both sides of the tenth or last incomplete segment, one also having an extra plate on one side of the penultimate segment. If each side is considered separately in these four asymmetrical specimens, one side will have nine trunk segments and the extra plate on the first caudal segment, while the other side will be found to have 10 trunk segments with the extra plate on the last trunk and none on the first caudal. The two chief trends of variation in *zosteræ* are thus indicated on either side of each one of these four variants, the last trunk segment having had the lower lateral ridge shortened on one side only, the last trunk segment thus having changed to a caudal segment on that side.

*Population divergence.*—The relative frequency of occurrence of the two chief variations as described in the preceding paragraphs differs markedly with locality and may be used in racial or varietal distinction as follows (for the sake of brevity these differences may be indicated by reference to the number of trunk segments, but the other correlated differences also occur as described):

By reference to table 5, it will be noted that nine trunk segments are possibly the dominant condition at Pensacola, although the number of specimens studied is not sufficient to be certain. Anyway, the percentage of such specimens must be high. In the Captiva Pass lot a little less than a third of the specimens have nine trunk segments, while in the Key West population a little less than a fifth have nine trunk segments. Among the specimens enumerated as having 10 trunk segments in table 5, two from Pensacola and two from Captiva Pass have the last segment incomplete and may be counted as having

nine segments on one side. Consequently, the decided or predominant tendency shown by the more northern populations of having one segment less than the population from Key West is actually more pronounced than indicated by the figures in table 5. Besides the decided difference in the number of trunk segments, table 5 also shows a less decided but apparently significant difference in the frequency distributions of the number of pectoral rays. While the number of specimens studied is too small for a thoroughgoing racial analysis, it seems evident that *zosteræ* tends to break up into distinct stocks in spite of its comparatively restricted geographic range.

*Distinctive characters and relationships.*—*H. zosteræ* may be distinguished easily from its congener occurring in its range, *punctulatus*, by the smaller number of fin rays and trunk segments and its much smaller size. The number of caudal segments is also generally less, but there is a small degree of intergradation in this character. This species is closely related to *regulus* and the difference between them has been discussed (p. 585).

*Material examined and geographic distribution.*—All localities on the coast of Florida, as follows: Cape Florida (67658, three dried specimens). Biscayne Bay at Bonefish Banks, November 27, 1906 (57236). Newfound Harbor Key, Pine and Bean, December 7, 1906 (57453). Key West (92717, April 15–27, 1884, *Albatross*, 1 specimen; also 15 specimens collected on seven different dates by the staff of the Bureau of Fisheries Biological Station). Boca Chica, April 11, 1922. Captiva Pass; O. P. Hay (Field Mus. Nat. Hist. no. 2131). St. Martins; January 17, 1902; *Fish Hawk* (73242). Pepperfish Key; November 21, 1901; *Fish Hawk* (73241). Apalachicola Bay; S. Stearns; 1880 (26595, this specimen found inseparably mixed in same bottle with 30753). Pensacola; S. Stearns (30753, mixed with the preceding specimen as noted; also 31920).

Total number of specimens examined, 59; 29, with a brood pouch or at least a rudiment of one, 25 to 44 mm long; 30, with no trace of a brood pouch, 24 to 44 mm long. Biscayne Bay to Pensacola, therefore, must be regarded now as representing the geographic range of this species, and unquestioned records from other places that may be referred to the present species are not known to me. The reference of *rosamondæ*, from Cuba, to the synonymy of *zosteræ*, as noted in the next paragraph, must remain in doubt until the type is reexamined and compared with authentic specimens of *zosteræ*.

*Synonymy.*—In the description of *H. rosamondæ*, Borodin states that it differs from *zosteræ* " \* \* \* by having longer dorsal, longer snout and very scarce and small filaments on the head and by the absence of body's spines." The dorsal in *rosamondæ* (14 rays)

has more rays than usual for *zosteræ*, but it falls within its range of variation (see table 5). The number of filaments in *zosteræ* as well as all other species of *Hippocampus* depends on individual variability (see p. 511). The spines as shown on the figure are not strikingly different from those in *zosteræ*. Besides the relative development of spines differs markedly with age and sex. That leaves only the longer snout to be considered. The figure of *rosamondæ* does show the snout longer and the eye smaller than usual in *zosteræ*, but there is considerable individual variability in that respect, and in females it is usually somewhat longer than in the males. Some of the specimens of *zosteræ* examined have the snout nearly as long as in the figure of *rosamondæ*. On the basis of the available evidence, therefore, it seems that *rosamondæ* was based on a specimen of *zosteræ*. At any rate, the allegedly specific differences given in the original description fall within the range of variation of *zosteræ*.





**L.A. R. I. 75.**

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